UNITED STATES DEPARTMENT OF AGRICULTURE
FLOOD CONTROL COORDINATING COMMITTEE
WASHINGTON

INTERIM REPORT

RUN-OFF AND WATER FLOW RETARDATION AND SOIL EROSION PREVENTION FOR FLOOD CONTROL PURPOSES

BOISE RIVER WATERSHED, IDAHO
Including
Work Plan For
WILLOW CREEK WORK UNIT

In compliance with
Section 6 of the Flood Control Act, June 28, 1938
Public No. 761 - 75th Congress
and
The War Department Civil Appropriation Act, 1939, Approved June 11, 1938
Public No. 591 - 75th Congress

FIELD FLOOD CONTROL COORDINATING COMMITTEE

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UNITED STATES DEPARTMENT OF AGRICULTURE

November 29, 1938
Date

SYLLABUS

A serious flood, sedimentation, and erosion problem has developed in the Boise River Watershed, Idaho. Spring floods have occurred in the highly developed, agricultural Boise Valley on the average of about once in every two or three years while sedimentation has occurred annually in the costly irrigation storage and diversion system, adversely affecting the entire population. Damage has exceeded $6,000,000 during the past 20 years and much greater damage is expected unless remedial measures are applied. Accelerated erosion and abnormally rapid run-off on depleted range and on burned, cut-over, and placered timber areas in the headwaters have been major contributing factors to the problem.

The Willow Creek Work Unit, embracing about 77,000 acres of depleted range land directly tributary to the Arrowrock Reservoir and constituting about 3 percent of the watershed, is one of the principal sediment producing areas. Prevention of accelerated erosion and retardation of run-off on this area can be effected by a program of range rehabilitation and supplementary channel improvements at a cost commensurate with the benefits to be derived. Based on investigations and experience within the area, a work program under the direction of the Forest Service is proposed which will require $138,850 of flood control funds, $166,500 of CCC operating expenses exclusive of CCC labor and housing costs, and the use of a CCC camp for about 3 years.

The Field Coordinating Committee recommends that the Option A program herein described be approved for immediate operation.

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AUTHORITY

1. This interim report is made in compliance with (1) The Flood Control Act of June 28, 1938, Public No. 761, 75th Congress which reads in part as follows:

"Section 6.....the Secretary of Agriculture is authorized and directed to cause.....surveys for run-off and water flow retardation and soil erosion prevention on the watersheds of.....BOISE RIVER, IDAHO," and (2) The War Department Civil Appropriation Act, 1939, approved June 11, 1938, Public No. 591 - 75th Congress, which appropriated for the Department of Agriculture $3,000,000 for examinations and surveys and $4,000,000 for prosecution of watershed works.

GENERAL STATEMENT

2. Pending the completion of detailed surveys over the entire Boise River watershed, which are now in progress, the present interim report summarizes the information now available concerning the flood problem in this drainage basin; and includes plans for an immediate operation program for run-off retardation and soil erosion prevention work on the Willow Creek Work Unit. Specifications for the latter program were developed through detailed field surveys by the Boise River project crew during the fall months of 1938.

BOISE RIVER WATERSHED, IDAHO

DESCRIPTION

3. The Boise River watershed, of which the Willow Creek Work Unit is a part, is located in southwestern Idaho (map 1). This watershed covers approximately 4,014 square miles, including about 167 square miles of bench land south of the drainage, most of which is irrigated by water diverted from the Boise River.

4. The climate is characterized by dry, warm summers and moist winters with freezing temperatures. In Boise Valley temperatures are favorable for plant growth from about March 15 to November 1, but precipitation which occurs largely as winter snow and as spring and fall rains is inadequate for crop production. In the mountainous portion the growing season is progressively shorter from the foothills near the City of Boise to the headwaters; while precipitation, conversely, increases. Deep accumulation of winter snow on the headwater areas is the primary source of both irrigation water that makes intensive agriculture possible in the arid Boise Valley and flood producing stream flow.

5. The principal tributaries of the Boise River rise in the eastern two-thirds of the watershed, which is a deeply and intricately dissected mountain mass that ranges in elevation from about 3,000 feet at Diversion Dam near Boise to nearly 10,000 feet along the Sawtooth Divide (map 2). From Diversion Dam to the Snake River, a distance of about 60 miles, Boise River flows through a broad valley of low relief in a shallow channel that traverses a flood plain.

6. Excessive deposition of sand and gravel and subsequent encroachment of willows and cottonwood trees have occurred in the main river channel from Arrowrock Reservoir to the Snake River due to contributions of sediment from seriously eroding areas on the watershed. Deposition is increased by regulation of streamflow by storage in Arrowrock Reservoir and diversion and storage in Deer Flat Reservoir which have prevented the normal scouring of the stream channel (plates 1 and 2). In its present condition, the main channel west of Boise has a capacity of only about 13,500 cubic feet per second. Water in excess of this amount overflows the banks and inundates parts of the flood plain.

7. The mountainous portion of the watershed is mostly granite, a part of the huge Idaho batholith that extends north and east into the Payette and Salmon River drainages, while formations of basalt, sediments, and recent alluvium cover the floor of the main valley and occur also in some tributary canyons and valleys in the dissected mountain mass (map 3). The granite of the mountain mass weathers into a loose, coarse-textured soil that is highly susceptible to sheet erosion, and to deep gullying in the drainage bottoms. The soils derived from the other geological formations are also readily erosible.

8. An extensive reconnaissance of the watershed was made in September 1938 at the initiation of this survey, and erosion conditions were classified as follows (map 4):

No perceptible accelerated erosion, largely timberland areas in the the headwaters and sagebrush valley bench lands.....1,476 sq.miles

Perceptible to moderately serious sheet erosion and minor gullying, on mixed forest and range areas.....1,947 sq.miles

Serious sheet erosion with some gullying, largely on depleted range and placered, burned, and cut-over timber areas..... 549 sq.miles

Serious channel disturbance, largely placer operations... 42 sq.miles

9. The soil, sand, gravel, and other material from the eroding lands is carried downstream where considerable quantities lodge in the reservoirs, diversion works, irrigation canals, and the main river channel, and in time of flood is spread over agricultural lands. This eroded material not only impairs costly irrigation structures but also contributes to the flood hazard by reducing the discharge capacity of the river channel through the Boise Valley. In addition, tributaries carry sediment and flood water into the City of Boise and other localized areas. It is estimated that probably more than four-fifths of the destructive sediment load of the Boise River is derived from areas involving only about one-fifth of the watershed area. Field inspections (table 1 and map 5) suggest that the Mores Creek Work Unit Area involving placered, burned, cut-over, and grazed timber lands is the heaviest contributor of sediment. The Willow Creek, Smith Prairie, Foothill, Sawtooth, Middle Fork, and Boise Valley Work Unit areas are next in order of importance (plates 1 to 4).

OCCUPANCY AND ECONOMY

10. Boise Valley was first settled in 1832 as a mission and trading post. Livestock grazing and a limited amount of irrigation agriculture followed which provided a local source of food for extensive gold mining and logging operations in Boise Basin near Idaho City during the period 1860-1900. During the period 1863 to 1896, about 45 million dollars of gold was taken out of the Mores Creek area (Idaho basin).[1/] Logging was also practiced on an intensive scale in the area. Up to 1935 when operations were greatly curtailed, about one and one-half billion board feet of lumber had been harvested. In 1902 it is estimated that 84,000 acres of valley lands were under irrigation. With the construction of Arrowrock Dam and an elaborate irrigation system, completed in 1917, this total was increased to approximately 350,000. Today, on the basis of federal, state, county, and city records, intensive agriculture in Boise Valley, range livestock production, mining, and related commercial activities constitute the major economic enterprises in the watershed, as shown by the following tabulation for 1937:

Retail sales	$31,100,000
Value of farm crops sold	9,000,000
Value of minerals sold	1,100,000
Value of timber products sold	50,500
Value of range livestock products sold	1,700,000

1/ Eighteenth Annual Report, U.S.G.S. 1898, Part 3, page 655.

11. The full value of real property subject to tax assessment approximates $140,000,000. The security of these values is dependent largely upon adequate supplies of water and related resources derived largely from the upper watershed.

12. Of the total population of 75,800 in the watershed, 74,300 live in the Boise Valley. About 30 percent of the total population live in the flood plain and are threatened by floods in the main stream. Floods of the tributaries, particularly those flowing through Boise, affect many people living outside the flood plain. In addition, many other people are affected by sedimentation in the irrigation system.

13. The Boise Valley is largely privately owned, while the foothills and mountains are mostly federally and state owned, although there are both large and small private holdings within the Boise and Sawtooth National Forests (table 2 and map 6).

14. Major land uses in the watershed include irrigation agriculture in the lower valley and on a few mountain ranches, while the foothill and mountainous portions are used largely for range livestock grazing, timber and fuel production, mining, and recreation (map 7).

15. Outside of the area in farms, the plant cover varies from sagebrush on lands in the lower valley and foothills to mixed grass and brush, mixed grass, weeds, shrubs, and timber in the headwaters, and dense timber in the Mores Creek drainage (table 3 and map 8). Approximately 6,650 cattle and 227,000 sheep grazed on these lands for varying periods in 1938.

16. Encroachment of intensive agricultural development on the flood plain has added to the flood and sedimentation problem, but irrigation land use practices in themselves have had little effect. However, regulation of stream flow through diversion and storage prevents the normal scouring of the downstream channel, resulting in deposition and reduced channel capacity. Partial regulation of the spring run-off by storage in Arrowrock Reservoir and diversion through the canal system to Deer Flat Reservoir has made it possible to reduce flood stages to some extent in most years since 1916, and has tended to reduce the flood problem along the main channel; but reduction is largely nullified by the prevention of the annual scouring referred to above. Overgrazing, improper logging, fires, road construction, and placer operations have caused accelerated erosion and rapid surface run-off on the foothill and mountain lands, resulting in both higher water and increased deposition down stream to accentuate the flood and sedimentation hazard.

HYDROLOGY

17. The major natural cause of floods in the Boise Valley is not prolonged heavy rainfall, but is the rapid melting of deep accumulations of winter snow in the mountains during the spring and early summer. On the 1,700,000 acres of mountainous area above Barber Dam, from 9 to 29 inches of water on the average and as much as 62 inches in some years have been measured as being held on top of the ground in the snow mantle over winter (table 4 and map 9). Snow on the foothills usually disappears by March 15, causing floods in small tributaries and moderately high flows in Boise River. Melting in the headwaters ordinarily does

not begin until after April 1, with the most rapid and extensive melting occurring in May. Maximum rates of melting and concurrent flood stages in the Boise River usually follow four or five consecutive days of high temperatures, while smaller variations also follow daily temperature fluctuations (fig. 1).

18. Local storms of short duration but high intensity occur during the summer, especially in the mountains. Records at Bannock Creek near Idaho City show that these storms may involve a total fall of 1.82 inches, with as much as 0.50 inch falling in 5 minutes. They have little effect on the regimen of the Boise River, but cause abnormally rapid run-off of silt and debris-laden water from tributary watersheds which furnish much of the sand and gravel that are carried and deposited down stream by the Boise River during high water stages.

19. Annual precipitation over the watershed as a whole ranges from less than 10 inches in the Boise Valley to 26 inches or more in the headwaters (table 5 and map 9).

20. The first major flood of reliable record occurred in the Boise Valley during the spring of 1896 due to run-off from melting snow in the headwaters (map 10 and fig. 3). At that time the Boise River reached a peak flow of 35,500 c.f.s. Lesser floods have occurred on the average about every other year in the valley, while local floods occur almost every year in some of the tributaries. Flood waters in the high gradient tributaries damage roads, bridges, farmsteads, and cause stream-bank erosion. In the lower valley the flood waters overflow the river banks and inundate extensive portions of the flood plain. The flood

flows move large quantities of coarse sand and gravel, some of which are carried on to Snake River, while the remainder is deposited in Arrowrock Reservoir, behind the Diversion and Barber Mill Dams, in the canal system, and in the main channel.

21. Total annual run-off above Diversion Dam has ranged from 897,900 to 3,301,340 acre-feet during the 42-year period of reliable records, with an average discharge of about 2,000,000 acre-feet. This is equivalent to a yield of about 14 inches of water from the 1,700,000 acres of watershed above Diversion Dam.

22. The normal regimen of the Boise River is characterized by low stages in late summer, fall, and winter and by high stages during the spring and early summer (fig. 2). As in the case of flood flow years, normal spring high water likewise moves large quantities of sand and gravel to the lower valley.

23. Under natural flow conditions, recorded maximum discharges have ranged from 3,797 to 35,500 c.f.s. Through partial regulation by storage in the 286,000 acre-foot Arrowrock Reservoir, maximum discharges at Diversion Dam have been reduced by as much as 7,600 c.f.s. as in 1927, but in most years reduction has been less than 1,000 c.f.s., and in four years the natural peak flow has been increased by draft on the reservoir (table 6). By diversion into the canal system and storage in the 170,000 acre-foot Deer Flat Reservoir, it is possible to reduce the rate of discharge through the main channel in Boise Valley by an additional 2,225 c.f.s., although in most years the amount of diversion during flood stages has been less than 1,000 c.f.s. Notwithstanding

the partial regulation of the river, the records show that discharges in excess of the present channel capacity, estimated at 13,500 c.f.s., are occurring as frequently as they did prior to 1917 when the Arrowrock Reservoir was completed (fig. 3 and plate 5). In view of the present limited capacity of the main river channel and the history of peak flow discharges to date, it is assumed that a flood of at least 1,000 c.f.s. in excess of channel capacity may be expected on the average about every 3 years; an excess flow of 5,000 c.f.s. about every 6 years; and one of 10,000 c.f.s. about every 14 years. Moreover, eventually there may be a recurrence of a major flood such as occurred in 1896, or one of even greater proportions. Such a flood, in view of the intensive development which has occurred since 1896, would cause a major disaster in Boise Valley.

FLOOD AND EROSION DAMAGE

24. Flood damage in Boise Valley includes the washing away of agricultural lands, the destruction of crops by inundation, the impairment of roads and bridges by undercutting, the flooding of buildings and industrial plants, destruction of irrigation headworks, and deposition of sediment in the irrigation canal system which involves not only the expense of cleaning canals but also a reduction in irrigation water during the growing season. Deposition in the Arrowrock Reservoir has reduced its storage capacity by more than 7,000 acre-feet. Cleaning and maintenance of the main channel have been required annually to prevent more serious flood damage (plate 9). Indirect damages include the loss of time and business during floods and reduction of land values due to

flood hazard. During the past 20 years floods have taken two lives and caused direct and indirect damage estimated to be in excess of $6,000,000 (table 7 and map 10). A flood of the same or greater magnitude of the one in 1896, the largest of record, would cause damage far in excess of the amounts to date.

25. Flood damage in the tributaries and on the watershed lands includes the washing out of roads and ranch lands and the loss of fertile topsoil by erosion. Accelerated erosion constitutes a dual element of damage as it not only is the source of sediment that is deposited down stream, but also because loss of fertile topsoil through erosion due to the destruction of vegetation by overgrazing, burning, timber cutting, and other causes has resulted in decreased forest and range productivity that will require many years to restore. It is estimated that serious erosion damage has occurred on about one-fifth of the watershed lands, primarily the foothill range areas, while about one-half of the watershed lands have been moderately damaged by erosion (map 4). Damage from sheet erosion has been negligible on the irrigated farm lands and in undisturbed timber areas.

FLOOD CONTROL PROJECTS OF OTHER AGENCIES

26. There has been no coordinated or comprehensive flood control program in the Boise River watershed. The City of Boise has constructed dams and channel improvements for controlling the tributaries that flow through the city. Boise and other communities, as well as county agencies and individuals, have made channel improvements along the main river, and at present WPA projects involving the expenditure of $107,000 of federal and $20,000 of local funds for rectification of the main channel are underway. Such improvements have been scattered and have

provided only temporary relief in local areas, and in some cases have accentuated the flood problem in other areas. Incidental protection has been provided in some years by the operation of Arrowrock Reservoir.

27. The construction of a 170,000 acre-foot combination storage, flood, and power reservoir at Twin Springs on the Middle Fork above Arrowrock Dam has been proposed but this structure will not prevent floods in highest run-off years. At a Public Hearing in Boise on September 8, 1937, local interests expressed a desire to have the main channel of the Boise River enlarged so as to carry the maximum expected discharge. The Boise Project Board of Control is considering the installation of sand traps on the main irrigation canals as a means of reducing sedimentation damage.

FLOOD PROBLEMS AND REMEDIAL MEASURES

28. Floods, sedimentation, and accelerated erosion have occurred in the watershed as a result of such interrelated factors as rapid melting of snow during the spring on headwater lands; inadequate capacity of reservoirs, canals, and the main river channel for carrying peak-flow discharges; and excessive contributions of sand and gravel from seriously eroded overgrazed range, placered, burned, cut-over, and otherwise disturbed areas on the watershed. By inundating valuable valley lands and improvements, causing deposition in costly irrigation developments, and by impairing the productivity and normal water-yielding functions of the watershed lands, in excess of $6,000,000 damages have occurred in the valley exclusive of damage on the upper watershed lands during the past 20 years. The damage has occurred largely in Boise Valley where and intensive agricultural economy has developed, but silt is also being carried into the Snake River, and down stream to the Columbia River.

29. Because of the high flood frequency, the limited capacity of the main river channel, and the increased development of the flood plain, future damage will increase and may reach disastrous proportions unless effective remedial measures are applied.

30. The remedial measures required for controlling floods, sedimentation, and accelerated erosion in the watershed include (1) vegetative and supplementary mechanical works on the watershed lands for run-off retardation and erosion prevention purposes, and (2) major mechanical structures such as the proposed Twin Springs reservoir, and traps on the irrigation canals and channel improvements in the Boise Valley. The major mechanical structures now being considered for application may prove to be immediately effective in the control of floods in the watershed. However, in view of the large amounts of sand and gravel now being moved in the stream channel and the large annual contribution of sediment from eroding areas, together with the reduction in the normal scouring capacity of the river due to storage and diversion, the usefulness of these structures will be short-lived unless destructive sediment can be stopped at its source. Vegetative and supplementary mechanical works on the watershed lands that will retard run-off and prevent erosion therefore constitute an essential part of the control program.

31. Aside from the general encroachment upon the flood plain by development in the valley, and sedimentation due to utilization of irrigation water through storage and diversion, one of the major man-made causes of the flood problem has been the unwise use of the plant and soil resource on the watershed lands. Originally the watershed lands were grazed, cut-over, and burned without regulation. In 1906 much of

the headwater area was placed under national forest administration, at which time regulated use and protection were initiated. In 1930 the Boise National Forest boundary was extended and additional regulation and protection was effected. Much of the Public Domain land in the valley and foothill portion is now in Idaho District No. 1 of the Division of Grazing, which has been organized recently. Extensive areas on the watershed were so misused prior to the establishment of federal regulation that many of these areas have not recovered and are continuing to erode seriously. Some of the eroding lands are in private ownership and are not subject to regulation. Proper use of these lands is essential for the application and maintenance of remedial measures. Proper use of private lands might be accomplished through the formation of soil conservation and flood districts, zoning, public acquisition, or other means. However, there is no enabling legislation for zoning or for the formation of conservation districts.[1/] The Idaho statutes permit the creation of flood control districts but none has been formed. The Arrowrock Addition of the Boise National Forest is in a purchase unit and private lands therein are being acquired. The state constitution[2/] charges the State Board of Land Commissioners, among other responsibilities, with the protection of state lands and the legislature is given power to authorize exchange of granted lands of the state for other lands under agreement with the United States. In order that financial aid and cooperation from the Federal Government may be taken

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1/ Idaho Session Laws, 1937, Chapter 215.

2/ Section 8, Article 9.

advantage of, the commissioners may cooperate or join with the United States in any matter pertaining to the use, control, and administration of any land now owned or later acquired by the state. Another way of obtaining proper use of the private lands is through voluntary cooperation and agreements with the CCC for applying remedial measures and improvements.

32. Watershed protection efforts have been inadequate and flood and erosion damage is continuing. Intensive treatment involving additional capital investments are required to obtain effective results and the scope and seriousness of the problem justify federal participation.

33. Improvement is needed on all the work units in the watershed. The Willow Creek Work Unit has been selected for an immediate action program because it is one of the most seriously damaged areas, contributes materially to deposition in Arrowrock Reservoir, and to the flood problem in Boise Valley, and also because, through a relatively simple program, the application of control measures can be effected without delay.

WORK PLAN FOR WILLOW CREEK WORK UNIT

GENERAL STATEMENT

34. Description of area: The Willow Creek Work Unit is located south of Arrowrock Reservoir (map 11). The area covers approximately 77,600 acres or about 3 percent of the Boise River watershed. It includes the drainages of Willow, Grouse, Cow, and several short tributary creeks of the South Fork of the Boise River, all of which drain into Arrowrock Reservoir.

35. Freezing temperatures generally prevail during the winter months except for occasional daytime thawing temperatures on south aspects. The summers are warm and dry, with a growing season that usually extends from about March 1 to November 1. The area is normally snow-covered between December 1 and February 15, though not too deeply to preclude yearlong construction activities.

36. The area is a deeply dissected mountain mass with steep slopes and high gradient channels which are conducive to rapid run-off and erosion (plate 6). Elevations range from about 3,200 feet at Arrowrock Dam to 6,700 feet at Danskin Peak. The predominant slopes average between 50 and 65 percent, except for a basin of about five square miles in upper Willow Creek where slopes average less than 20 percent. The stream channels have an average gradient of about 5 percent with steeper gradients in the extreme headwaters and occasional sectors of only 1 percent. Stream bank cutting is common; and extensive sand

and gravel bars occur in the low gradient sectors. While the gradients generally are too steep for the feasible construction of large silt detention basins, the low gradient sectors provide opportunities for low stabilizing check dams (plate 7).

37. Except for a narrow fringe of basalt at the lower elevations, the area is largely granite which weathers into a shallow, coarse, erosive soil of varying depth, mostly from 6 to 12 inches deep.

38. Originally characterized by stabilized slopes and channels, sheet erosion, gullying, and channel cutting are now widespread as a result of plant cover depletion by overgrazing and fires. A combination of detail, reconnaissance, and spot sampling surveys was made on about 13 percent of the area in 1938 (table 8 and map 12). From these observations (tables 9a, 9b, and 9c, and maps 13 and 14) it is estimated that about 20 percent of the area is moderately eroded (25 to 50 percent of the fertile topsoil removed) while about 75 percent of the area is moderately severe to severely eroded (50 to 75 percent or more of the fertile topsoil removed). In addition, it is estimated that approximately 450 miles of deep gullies have developed. The most serious and extensive erosion is on south aspects, particularly on areas which formerly supported perennial bunchgrass but which now are characterized by such annual plants as kitchenweed, China lettuce, and downy bromegrass. The removal of soil from these eroding areas and from the cut banks of the streams constitutes a major source of the damaging sediment in Arrowrock Reservoir and of the sediment load of the Boise River (plates 8, 1, and 2).

39. Occupancy and Economy: The area has been used since 1878 almost entirely for grazing sheep, cattle, and horses during the spring, summer, and fall months. A number of homesteads were established in the valley bottoms throughout the area, but because of crop failures and depletion of the range, they have been abandoned except for one small ranch in the headwaters of Willow Creek. The original bunchgrass cover furnished spring, summer, and fall range forage annually for as many as 6,000 cattle and 38,000 sheep during the period 1908-1912, but this use and range fires resulted in serious depletion of the plant cover and greatly reduced grazing capacity.

40. About 64 percent of the area is covered by sagebrush, 21 percent by mixed shrubs including chokecherry, snowberry, rose, and ceanothus, 14 percent by annual plants, principally kitchenweed, China lettuce, and downy bromegrass, and less than 1 percent by timber (table 10 and map 15). The bunchgrasses (wheatgrass, Idaho fescue, and junegrass) once common on the area have largely disappeared except on relatively inaccessible north aspects in the extreme headwaters of the tributaries. The depletion of the perennial bunchgrasses doubtless has been a major contributing cause of the rapid surface run-off and widespread accelerated erosion that now occurs on the area.

41. The relation of plant cover depletion and related factors to the occurrence of run-off and erosion is indicated by results of investigations on this area. In 1930, Renner 1/ found accelerated erosion to be widespread. This condition was associated most commonly

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1/ Renner, F. G. "Conditions influencing erosion on the Boise River watershed." U.S. Dept. of Agriculture, Technical Bull. No. 528, 1938.

with intensive range use, annual weed type, soils lacking in humus and litter, south aspects, low plant density, rodent disturbance, and steep slopes. Through detailed measurements with portable apparatus, which simulated summer storm conditions, Craddock and Pearse [1] found that the original perennial bunchgrass range is 150 times more effective for controlling surface run-off and 2,500 times more efficient for controlling erosion than the annual weed type of cover than now occurs on much of the area. Pearse and Woolley [2] also found in absorption studies that the presence of plants greatly increases infiltration of surface water by soils as compared to bare areas.

42. The entire work unit is within the Boise National Forest, the forest boundary having been extended in 1930 to include the Arrowrock Addition of which this area is a part. At present approximately 68 percent of the area is federally owned, 10 percent State owned, and 22 percent privately owned (table 11 and map 16). An acquisition program to purchase the private lands was instituted in 1935. Approximately 6,000 acres have been purchased or are under option for immediate acquisition, while it is expected that an additional 8,000 to 10,000 acres will be acquired or under option before June 30, 1939.

43. The entire area is suited only for grazing and for the year 1938 supported 13,500 sheep and 1,000 cattle for periods of from 1-1/2 to 6 months, or the equivalent of 10,874 animal-months (table 12). The area

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1/ Craddock, George W. and Pearse, C. Kenneth. "Surface run-off and erosion on granitic mountain soils of Idaho as influenced by range cover, soil disturbance, slope, and precipitation intensity." U. S. Dept. of Agri. Circ. No. 482, 1938.

2/ Pearse, C. Kenneth and Woolley, Samuel B. "The influence of range plant cover on the rate of absorption of surface water by soils," Jour. of Forestry, Sept. 1936.

embraces seven national forest grazing allotments (map 17). In 1938, about 4,000 animal-months grazing use was permitted on lands under national forest control which included in addition to national forest lands, some leased state and private lands on which grazing privileges had been waived in lieu of use on other areas. Uncontrolled grazing on privately owned and leased state lands within these allotments amounted to about 6,800 animal-months. These lands are grazed much more intensively than national forest lands as they provide 63 percent of the grazing use but amount to only about two-fifths of the total area. The present grazing use for the area as a whole is about one-sixth of that during the peak years of 1908-12 and probably about two-fifths of the estimated original carrying capacity.

44. The normal value of range lands in good condition in this area is estimated to be about $2.50 per acre. However, under the present state of depletion the average per acre value of the area as a whole probably does not exceed one-half of this figure. The schedule of values set for use in the existing acquisition program ranges from 25 cents per acre for lands classed as waste to a maximum of $3.50 for the best grazing lands. These prices, however, include not only the physical value of the land itself but also such intangibles as accessibility, proximity to headquarter ranches and shipping points, strategic location with respect to water and other range areas, public grazing rights and privileges, and other factors not related to physical producing capacity.

45. Grazing fees on national forest lands amount to about 4-1/2 cents per sheep-month and approximately 17 cents per cow-month. Income from this source on the national forest in 1938 totaled about $825.00.

State and private land is commonly leased for grazing purposes at from 7 to 12-1/2 cents per acre. On that basis and with the further consideration of the total grazing use on private and state owned lands, the annual income from grazing rentals of these lands approximates $2,000, or a total of probably less than $3,000 for the entire work unit.

46. Stream flow within the area furnishes water for range livestock, while run-off from the area flows into Arrowrock Reservoir and is used in Boise Valley primarily for irrigation, but also for power and domestic purposes.

47. Because the area is used almost exclusively for grazing livestock, the proper management and public acquisition of private lands constitute the major institutional considerations in an improvement program. On national forest lands grazing control is exercised and because such lands are in federal ownership they can be treated without delay. Although treatment will involve reduction of livestock numbers in the area, this can be accomplished largely without reduction of established grazing privileges through redistribution. While the use of state lands is not subject to control by zoning or by soil conservation districts, cooperation with the State of Idaho is possible. The program of acquisition of private land now going forward will permit the control and treatment of these lands. Because there is negligible occupancy in the area, other institutional problems are of little importance as they relate to a work program.

48. Hydrology: Precipitation records are meager but on the basis of a short record at the Arrowrock Substation within the area and longer records at Arrowrock Dam, Prairie, Ostner's Ranch, and McDonald's Ranch (table 5 and map 9) indications are that annual precipitation averages between 16 and 20 inches at the lower elevations and between 21 and 25 inches in the headwaters. Precipitation during the winter occurs chiefly as snow. Some melting and infiltration occurs during the winter, but a shallow, dense snow mantle containing from 5 to 10 inches of water normally remains on the ground until general melting begins in the spring. In addition to general rains of moderate intensity, local storms of short duration but high intensity and involving amounts seldom in excess of 1.50 inches per storm, occur during the spring, summer, and fall months.

49. Floods occur in the tributaries of this area each spring, usually in early April as a result of rapid snow melting, while at least one or more floods occur during the spring, summer, or fall during local rains of high intensity. The floods are local, inundating sectors of the creek bottoms with high velocity, sediment-laden water. The only records applicable to the area show that Willow Creek reached a peak flow of 234 c.f.s. on April 1, 1917, or the equivalent of about 3.0 c.f.s. per square mile of drainage. Boise River did not reach its highest stage that year until about 2-1/2 months later, at which time the discharge was 11,400 c.f.s., or the equivalent of about 4.3 c.f.s. per square mile of drainage above the Diversion Dam. The tributaries of this area reach very low stages during the summer months.

50. Flood Damage and Erosion Loss: Because of their early occurrence the peak flow discharges from the Willow Creek Work Unit do not contribute directly to the major flood stages of the Boise River, but they are an important contributing factor to the flood and sedimentation problems in the main Boise River and the lower Boise Valley. The rapid surface run-off both from melting snow in the spring and from summer rains, removes fertile topsoil from the slopes (plates 10 and 11), while the high velocity flows in the drainage bottoms (plate 12), and channels by scouring and undercutting transports large quantities of sand, gravel, and boulders. Part of the eroded material is deposited in the low gradient sectors of the tributaries (plate 7), and on roads and formerly cultivated field while part is carried downstream to be deposited in Arrowrock Reservoir (plate 8). Some of the sands and gravels are sluiced through Arrowrock Dam in the fall to become lodged in the main river channel, the diversion works, (plates 1 and 2) the irrigation canals (plate 9), and in the main river channel in Boise Valley. By contributing to the reduction in the capacity of the irrigation system and the main river channel, the sediment-laden discharge from this area constitutes an indirect but important cause of flood and sedimentation damage in Boise Valley. It is impossible to evaluate accurately the contribution of the area to the downstream flood problem. However, in view of the fact that damage downstream has exceeded $6,000,000 during the past 20 years (table 7) and damage in the future is expected to be much greater, the necessity for preventing further contributions of sediment from the Willow Creek Work Unit is evident.

51. In addition to contributing to a downstream flood problem, considerable flood and erosion damage also has occurred within the Work Unit. Cultivated lands have been abandoned because of erosion, deposition, and destruction of irrigation works. Roads and bridges have been washed out and made impassable by deposition. Extensive areas of range lands have decreased in productivity as a result of overgrazing and subsequent serious erosion. It is estimated that in excess of $200,000 damage has occurred within the area in the past 20 years as tabulated below:

Damage Items	20-Year Total 1917-1938	Average Annual Damage
Road and bridge repairs and maintenance	$70,000	$ 3,500
Abandonment of agricultural land	20,000	1,000
Reduced capital value of range lands	116,000	5,800
Total	$206,000	$10,300

52. Flood and Erosion Problems and Remedial Measures: The local flood, sedimentation, and erosion problem within the area and the contribution of this area to the flood and sedimentation problem in Boise Valley has arisen out of a combination of physical and economic factors as follows:

a. Steep slopes and high gradient channels are conducive to rapid run-off and erosion, and to high velocity discharge from the area.

b. The accumulation of 5 to 10 inches of water in the snow mantle constitutes an annual spring flood hazard, while local storms of high intensity cause one or more floods in other seasons.

c. Serious sheet erosion is occurring on three-fourths of the area and there are about 450 miles of unstable gullies.

d. The present grazing utility of the area is only about two-fifths of its normal capacity due to depletion by overgrazing, fire, and subsequent soil erosion. Annual weeds which are ineffective for controlling erosion and are inferior for grazing are practically the only plants on about one-seventh of the area and have succeeded perennial bunchgrasses to a large extent on the remaining area.

e. The area was so seriously depleted when it was added to the Boise National Forest that it has not been possible to bring about restoration of national forest lands under ordinary Forest Service regulations because of the short period of time involved and the large amount of additional capital investments required.

f. Uncontrolled grazing use on interspersed private and state lands has resulted in serious and continuing depletion of the range resource and accelerated erosion.

53. These factors combined have resulted in serious flood and erosion damage within the Work Unit and have contributed materially to the major flood and sedimentation problem in Boise Valley. Investigations show that the restoration of the plant and soil mantle to a condition approaching normal will be effective for retarding run-off and preventing accelerated erosion. Because of the seriousness of the flood and erosion problem, the high percentage of federal lands involved, the federal reclamation projects concerned, and the inability of local interests to meet the situation, the application of remedial measures is a responsibility in which the federal government has a major interest.

54. The restoration and maintenance of an effective plant and soil mantle which will retard surface run-off and prevent erosion may be accomplished through a combination program of vegetational and mechanical measures, with the methods and intensity of application depending upon the physical conditions on the area, the rate of improvement desired, and cost limitations. The reasonably applicable measures and the physical conditions warranting their use, as determined by research, surveys, and experience (plates 13 and 14 and maps 13 and 14) on this and comparable areas, are as follows:

Restricted grazing involving a reduction in the intensity of use, and investments in livestock control fences and other range improvements, will permit the restoration of satisfactory watershed conditions through natural revegetation on areas characterized by: slight erosion; surface soil friable, dark colored, 6 - 12 inches or more in depth; plant and litter mantle not seriously depleted; slopes less than 60 percent. Temporary exclusion of grazing will be required to accomplish the same results on areas characterized by: moderate erosion; surface soil moderately compacted, organic content partially depleted, 6 - 12 inches deep; plant and litter mantle depleted, but with at least one perennial bunchgrass per 100 square feet; and on any slope.

Planting of grasses by drill on contours and temporary exclusion of grazing are recommended for areas characterized by: moderately severe erosion but with no definite gully system; surface soil at least 6 inches deep; less than one perennial bunchgrass per 100 square feet; and slopes up to 60 percent.

Planting of grasses by broadcast sowing and temporary exclusion of grazing are recommended for slopes in excess of 60 percent, but otherwise similar to areas requiring contour seeding.

Contour trenching followed by artificial reseeding and exclusion of grazing is recommended for areas characterized by: moderately severe to severe erosion with definite gullies less than 2 by 2 feet in depth and width; workable soil material 6 inches or more in depth; less than one perennial bunchgrass per 100 square feet; and slopes less than 60 percent.

Shrub planting is recommended for treating gullies larger than 2 by 2 feet in width and depth, unstable roads, eroding cuts and fills; unstable undercut stream banks; and shallow, gravelly areas unsuited to contour trenching or artificial reseeding.

Mechanical structures including check dam-debris basins are recommended for application in low gradient stream channel sectors characterized by unstable sand, gravel, and boulder deposits and undercut banks.

55. A work program can be started immediately on national forest lands which constitute about 70 percent of the area. Forest Service acquisition of private lands is proceeding, and it is expected that by July 1, 1939 at least one-half of these lands will have been acquired, while in addition it may be possible to work out cooperative arrangements with private owners whereby the remaining private lands can be included in the work program. It is believed that cooperation of the state can be secured on a mutually satisfactory basis for a work program on state owned lands, which constitute approximately 10 percent of the Work Unit area. There are no other institutional impediments of importance to a work program.

PLAN OF IMPROVEMENT

56. Detailed Plan of Improvement: Surveys which took into account the occurrence and extent of the physical conditions described above and the need for prompt and effective control, show that intensive treatment including artificial reseeding, shrub planting, contour trenching, mechanical channel control works, and at least temporary exclusion of grazing is needed on 25,010 acres, or about one-third of the area, while the remainder requires only restriction of grazing (table 13). These measures can be applied through two optional work programs: Option A being a comprehensive program involving a combination of improved land management practices, revegetational measures, and supplementary mechanical works; and Option B a program of similar measures applied on a more intensive basis. A program of fencing, restricted grazing, and improved fire protection only may result in the eventual restoration of satisfactory watershed conditions, but in view of the slowness of natural revegetation anticipated on this area, such a program (Option C) will not be effective for flood and erosion control purposes for many years. Many of the remedial measures proposed under Option A have been developed through experiments conducted at the Arrowrock Substation of the Intermountain Forest and Range Experiment Station on the area. On the basis of these experiments it is believed the work program proposed consists of sound rehabilitation practices.

57. Labor Requirements: The Option A program requires a total of 48,800 man-days force account labor or 154-100 man-days CCC labor, while a combination basis will require 14,350 force account and 116,050 CCC or a total of 130,400 man-days labor (table 14). The Option B program will

involve 149,700 force account man-days, or 449,200 CCC man-days; while a combination organization will require 61,500 force account and 311,300 CCC, or a total of 372,800 man-days labor. The Option C program can be accomplished with 6,800 force account or 44,600 CCC man-days labor, or by a combination involving 3,550 force account and 22,000 CCC, or a total of 25,500 man-days labor.

58. Cost Estimates: The estimated cost of the Option A program on a force account basis if $463,000; on a CCC basis $398,000 (exclusive of CCC labor and housing); and on a combination basis $350,350 of which total $138,850 is for force account and $166,500 for CCC operations exclusive of CCC labor (table 15). The Option B program costs are $1,166,900 force account, or $678,400 CCC (exclusive of CCC labor and housing), or $861,000 for a combination program of which $487,000 is force account and $374,400 is for CCC operations. The Option C program costs are estimated to be $68,300 force account or $59,800 CCC, or $63,290 for a combination basis of which $32,190 is for force account and $31,100 for CCC operations.

59. Availability and Adaptability of Labor: Through local inquiry it appears unlikely that any local agency will sponsor a WPA project on the work area because of the large amount of work already obligated by the WPA organization and because of regulations which practically prohibit the use of Boise Valley WPA laborers in a distant camp. There is an abundance of satisfactory force account labor available from the relief rolls in Boise Valley. There is no CCC camp in the Work Unit, nor is there any sufficiently close for use. The proposed work is well adapted to CCC operations, provided supplementary funds can be made available for

technical services, materials, equipment, etc., in addition to normal CCC operation allotments. Considering the limited amount of funds normally allotted to the sponsoring work agency for CCC operations and the relatively high cost of the work on a straight force account basis, it appears that the most economical organization for operations on this area is a CCC camp supplemented with force account funds.

60. The Work Unit contains two desirable camp sites which serve about equal portions of the area (map 18). Camp site No. 1 is located on a county road in the Woodtick Creek drainage about 35 miles from Boise. Ample water is available and the topographic and climatic conditions are satisfactory for a yearlong program, although operations in midwinter may have to be restricted to work on channel structures in the canyon bottoms. Camp site No. 2 is located on Willow Creek and is equally well adapted for yearlong operations. An abandoned road will require some improvement to make this camp site readily accessible.

61. It is estimated that the Option A work program can be accomplished in about 3 years with one 200-man CCC camp on a combination CCC-force account basis. On the same basis the Option B program will require two 200-man CCC camps for a period of 4 or 5 years, while the Option C program could be accomplished by a 100-man camp in about one year.

62. Analysis of Costs and Benefits: It is estimated on the basis of past experience and research (plate 13) that the Option A program will reduce the contribution of damaging sediment from this area by as much as three-fourths within 10 years, and will lead to control of accelerated erosion and to the restoration of the cover to a condition reasonably approaching its original state within 20 years. It is estimated that

the Option B program would practically eliminate the contribution of damaging sediment from the area in 5 or 6 years and would restore the cover to a condition approaching normal in probably less than 20 years, but would cost about three times as much as the Option A program. The Option C program probably would reduce the contribution of damaging sediment from the areas by about one-tenth in the next 10 years, but in view of the slowness with which recovery takes place on these seriously depleted lands under natural conditions, it would probably require as much as 50 years for the control of accelerated erosion and the restoration of the original plant cover.

63. An immediate economic effect of any of the optional work programs would be reduced income from livestock grazing in the area. While the determination of the amount of grazing reduction involved under the various options will depend upon the results of a detailed range survey, total exclusion probably would not involve an annual loss of gross rental income in excess of $3,000, the present estimated total. This amount in the absence of a work program would otherwise continue to be less in view of the present progressive reduction of carrying capacity. While all of the optional programs might be equally effective in the long run, it is believed that Option C is the least desirable because of the long time required for it to yield effective results. By reason of its relatively high cost, the Option B program appears to be less desirable than the Option A program which, at about one-third the cost, will yield equally effective results in a reasonable period of years. Although the proposed expenditures under Option A exceed the normal value of the lands for grazing purposes, and it is impossible at this time to set forth a monetary equation of costs and benefits, it is

believed that total benefits to be derived by the community will justify the costs. The program will effect the reduction of downstream damage, is a necessary prerequisite to downstream flood control works, will preserve the source of irrigation water on which the economy of the Boise Valley is largely dependent, and in addition will rehabilitate the lands themselves.

64. Cooperation and Maintenance: The Department of Agriculture through the Forest Service and the Soil Conservation Service can undertake the application of this program immediately and will provide for the future protection and maintenance of the improvements.

RECOMMENDATIONS

65. It is recommended that the Option A work program be undertaken immediately; that a CCC camp with an allotment of not less than $166,500 for operation expenses, exclusive of CCC labor and housing costs, be assigned to the Boise National Forest for participation in the program; that an additional sum of $138,850 of flood control force account funds be allotted to this project; and that the Forest Service assume the primary responsibility for the operation of the program.

APPENDIX A

PLATES

Number	Title
1.	Silt and sand deposits in the Diversion Dam pool near Boise, Idaho.
2.	Barber Mill pond near Boise, Idaho.
3.	Placer and hydraulic mining operations near Idaho City, Idaho.
4.	The Foothills near Boise, Idaho.
5.	Arrowrock Dam near Boise, Idaho.
6.	Upper Grouse Creek showing topography.
7.	Extensive sand and gravel bar, Woodtick Creek.
8.	Sediment deposits in Arrowrock Reservoir.
9.	Removing annual deposit of sand and gravel from New York Canal near Boise, Idaho.
10.	Sheet erosion on moderately depleted range area, Willow Creek Work Unit.
11.	Serious sheet erosion and gullying, range area in Willow Creek Work Unit.
12.	Deep gully and fresh gravel deposit in Willow Creek Work Unit.
13.	A tributary of Woodtick Creek in the Willow Creek Work Unit.
14.	A dense stand of perennial bunchgrass on uneroded portion of Boise River Watershed, Idaho, and portable apparatus for measuring its effectiveness for controlling erosion.

Plate 1.

Silt and sand deposits in the Diversion Dam pool near Boise, Idaho. Debris accumulates each year as a result of accelerated erosion and is partially removed by sluicing as indicated by new channel directly behind the dam.

(Photograph No. A-Ida.-25171 through courtesy of 41st Division, Aviation, Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 1

Plate 2.

Barber Mill pond near Boise, Idaho, filled with sand and gravel brought down during high water stages from the Boise River Watershed, a result of serious accelerated erosion. Sluicing of the sand and gravel from the pond each fall increases deposits down stream. Flood hazards and damage to canals are thus increased.

(Photograph No. A-Ida.-25172 through courtesy of 41st Division, Aviation Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 2

Plate 3.

Placer and hydraulic mining operations, near Idaho City, Idaho. These lands formerly covered by ponderosa pine timber are an important source of the sand and gravel in the Boise River channel and irrigation canals. An operating gold dredge can be seen in lower left-hand corner.

(Photograph No. A-Ida.-25150 through courtesy of 41st Division, Aviation, Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 3

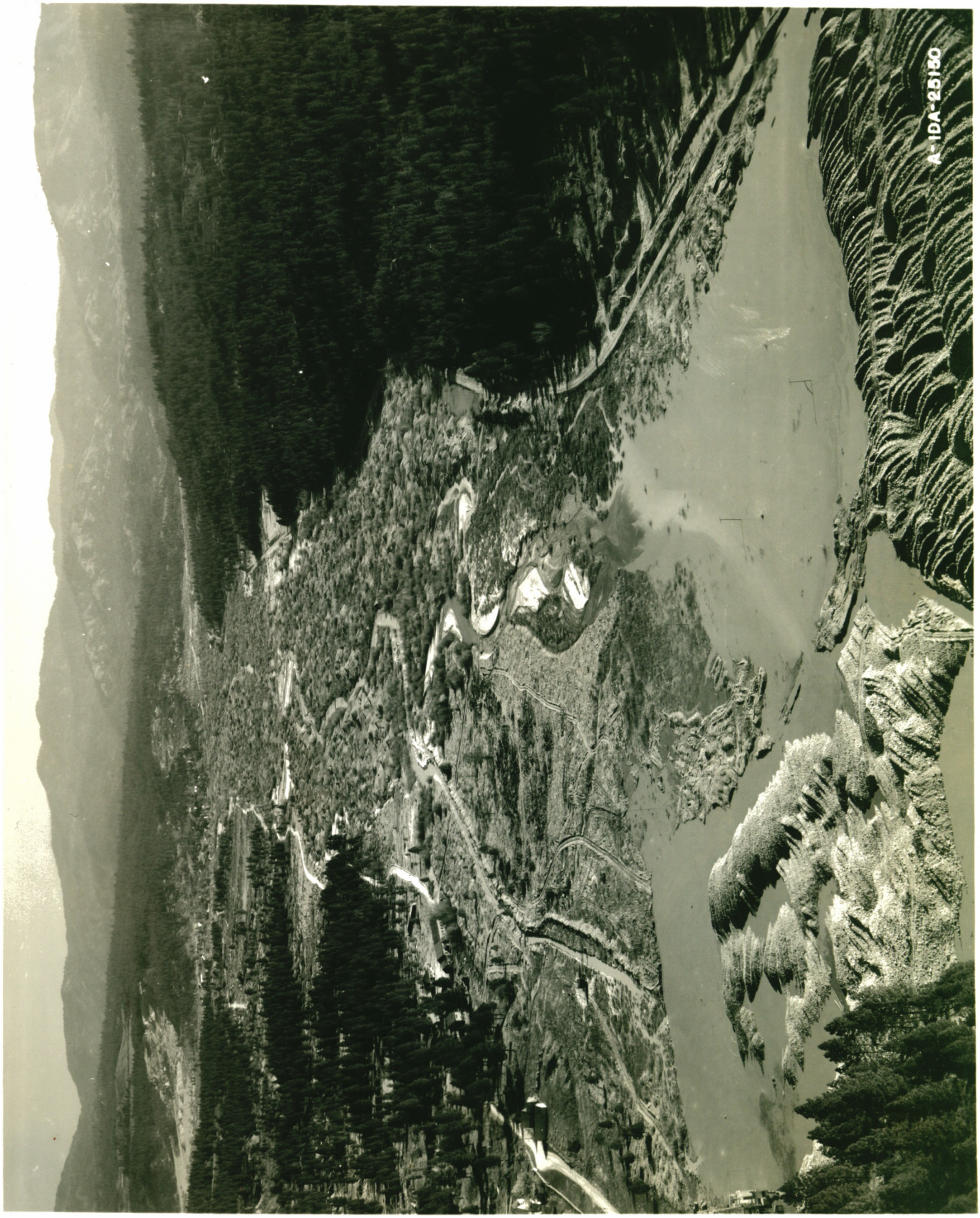


Plate 4.

The Foothills near Boise, Idaho, with depleted, eroding lands and excessive sedimentation in Freestone Creek, which carries flood waters and debris into the City of Boise.

(Photograph No. A-Ida.-25006 through courtesy of 41st Division, Aviation, Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 4

Plate 5.

Arrowrock Dam near Boise, Idaho, with approximately 9,000 second-feet of stored irrigation water passing through the upper ports.

(Photograph No. A-Ida.-25173 through courtesy of 41st Division, Aviation, Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 5

Plate 6.

Upper Grouse Creek showing highly dissected topography, steep slopes, and sediment deposits in the channel bottom. Accelerated erosion on the depleted range lands is the chief contributing cause of this soil movement.

(Photograph No. A-Ida.-25119 through courtesy of 41st Division, Aviation, Washington National Guard in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 6

Plate 7.

An extensive sand and gravel bar in a low gradient sector of Woodtick Creek. The remnants of a mountain farmstead which has been destroyed is shown in the foreground.

(Photograph No. A-Ida.-25142 through courtesy of 41st Division, Aviation, Washington National Guard in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 7

Plate 8.

Sediment deposits in Arrowrock Reservoir at the mouth of Grouse Creek, which drains eleven square miles of depleted range lands.

(Photograph No. A-Ida.-25157 through courtesy of 41st Division, Aviation, Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 8

Plate 9.

Removing the annual deposit of sand and gravel from the Main South Side (New York) Canal near Boise, Idaho, 1938. These deposits decrease the capacity of the irrigation canal system resulting in water shortages and decreased crop yields.

Plate 10.

Sheet erosion on a moderately depleted range area in the Willow Creek Work Unit. The present perennial plant cover consists of sagebrush, bitterbrush, balsamroot, and a few clumps of bunchgrasses, while annual weeds are present on the exposed soil areas. The prevention of erosion on this area can be accomplished by restricted grazing which will permit the recovering of the exposed areas by perennial bunchgrasses.

Plate 11.

Serious sheet erosion and gullying on a depleted and trailed range area in the Willow Creek Work Unit. The present plant cover is mostly annual weeds. Retardation of surface run-off and erosion prevention can be accomplished on this area by contour furrowing and artificial reseeding.

Plate 12.

A deep gully and fresh gravel deposit in the Willow Creek Work Unit caused by abnormally rapid run-off from depleted range land. Gullies such as this can be stabilized by a combination of measures including the planting of shrubs on the cut banks, the construction of contour furrows around the gully head and by the restoration of plant cover through natural and artificial revegetation on the tributary slopes.

Plate 13.

A tributary of Woodtick Creek in the Willow Creek Work Unit on which Forest Service experimental contour seeding and furrowing (in central background only) have been applied for waterflow retardation and erosion prevention purposes.

(Photograph No. A-Ida.-25145 through courtesy of 41st Division, Aviation, Washington National Guard, in cooperation with the Soil Conservation Service, Spokane, Washington, 1938)

Plate 13

Plate 14.

A dense stand of perennial bunchgrass on an uneroded portion of the Boise River Watershed, Idaho, and portable apparatus for measuring effectiveness of plant cover for controlling erosion. Tests with this apparatus show that the bunchgrasses are highly effective for controlling erosion as compared to annual weed plants which now occur on much of the watershed. The reestablishment of the perennial bunchgrass cover on depleted areas is an essential part of the program for controlling erosion on the Willow Creek Work Unit.

Plate 14

APPENDIX B

TABLES

Plate 14

APPENDIX B

TABLES

Table 1. - Erosion conditions in work unit areas, Boise River Watershed, Idaho.1/

Work Unit Area	Description			Erosion		
	Area		Cover or Use	None	Moderate	Serious
	Sq. Miles	Percent		Percent	Percent	Percent
1 - Boise Valley	664	16.54	Largely Cultivated	90	8	2
2 - Foothill	721	17.96	Range, Burns	20	50	30
3 - Mores Creek	448	11.16	Placer, Burns, Cut-over Range	2	30	68
4 - Willow Creek	114	2.85	Range	2	23	75
5 - Smith Prairie	465	11.58	Range, Timber	5	65	30
6 - Sawtooth	808	20.13	Range, Forest	5	75	20
7 - Middle Fork	794	19.78	Range, Forest	50	45	5
Totals	4,014	100.00	xxx	xxx	xxx	xxx

1/ Based on extensive inspection of watershed.

Table 2. - Land ownership classes, Boise River Watershed, Idaho, 1935. 1/

Land Ownership Classes	Area within watershed		Area outside watershed served by Boise Rv. irrigation water	
	Approximate Number of Acres	Percent of Total	Approximate Number of Acres	Percent of Total
Federal				
Department of Agriculture 2/	937,600	38.1		
Department of Interior 3/	261,120	10.6	6,400	6.0
State of Idaho	218,240	8.9	8,000	7.5
County	67,200	2.7	1,980	1.8
Private	977,920	39.7	90,500	84.7
Totals	2,462,080	100.0	106,880	100.0

1/ From compilations by Department of Agricultural Economics, University of Idaho, based on County Tax Rolls and Assessors Records.

2/ Principally national forests.

3/ Principally Public Domain under administration of Division of Grazing.

Table 3. - Generalized cover types and farm areas, Boise River Watershed, Idaho, 1938[1/]

Classes	Area within watershed		Area outside watershed served by Boise Rv. irrigation water		Total Area	
	Sq. mi.	Percent	Sq. mi.	Percent	Sq. mi.	Percent
Farm areas	420	10.9	158	94.6	578	14.4
Sagebrush	1,045	27.2	9	5.4	1,054	26.3
Mixed grass & brush	145	3.8			145	3.6
Timber:						
Burns	144	3.7			144	3.5
Dense timber	167	4.3			167	4.2
Cut-over timber	143	3.7			143	3.6
Mixed timber & range	1,783	46.4			1,783	44.4
Total	3,847	100.0	167	100.0	4,014	100.0

1/ Compiled from Forest Service records and Bureau of Reclamation Map No. 21,900.

Table 4. - Snow depth and water content on snow courses, Boise River Watershed, Idaho 1/

Station	Amount in Inches																	
	1930		1931		1932		1933		1934		1935		1936		1937		1938		Mean annual	
	D*	W*	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W
Soldier's Summit Elev. 6100'																	47	19	47	19
Mores Creek Elev. 6100'	51	16	50	17	80	14	68	28	53	18	59	21	95	34	67	24	105	35	68	23
Bald Mountain Elev. 6250'													80	26	62	24	75	26	72	25
Coonans Cabin Elev. 6400'													55	20	40	15	36	12	44	16
Red Fish Lake Elev 6600'															28	7	40	11	34	9
Galena Summit Elev. 7500'																	85	28	85	28
Trinity R. S. Elev. 7700'	82	32	63	23	100	47	87	38	67	28	117	42	118	51	80	30	138	62	94	29
Atlanta Summit Elev. 8500'	76	24	52	20	85	30	79	27	57	18	76	27	85	36	70	24	118	41	78	28

*D=Depth; W=Water Content

1/ From Forest Service and Bureau of Agr. Engineering records.

Table 5.- Mean monthly and annual precipitation in inches, Boise River watershed, Idaho. 1/

STATION	PERIOD OF RECORD	ELEV-ATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
Parma	1922 - 1937	2224'	1.05	.76	.65	.84	.54	.74	.13	.20	.34	.67	.91	1.01	7.90
Boise	1864 - 1937	2739'	1.59	1.40	1.50	1.25	1.12	.72	.25	.15	.33	.86	1.24	1.50	11.87
Arrowrock Dam	1911 - 1937	3230'	2.70	2.31	2.04	1.58	1.09	.80	.34	.21	.42	1.09	2.30	2.32	17.21
Idaho City	1894 - 1937	4000'	3.31	2.62	2.38	1.50	1.28	.89	.48	.30	.54	1.30	2.55	3.44	20.76
Pine	1909 - 1937	4100'	4.24	2.80	1.92	1.40	1.31	.74	.35	.35	.56	1.45	2.66	3.24	20.45
Arrowrock Sub-Station	1937 - 1938	4500'	3.68	.64	4.16	.32	1.59	1.31	1.30	.00	.23	1.75	4.25	3.33	22.56
Bannock Creek	1935 - 1938	4000'	2.66	3.30	3.10	2.23	1.43	1.85	.70	.65	.29	.74	1.71	3.25	20.15
Atlanta	1898 - 1937	5500'	3.47	3.33	2.40	1.58	1.27	1.15	.64	.65	.79	1.75	2.13	3.37	22.51
Baumgartner Park	1933 - 1937	4900'	1.82	1.18	1.16	.49	.82	.76	.26	.13	.62	1.24	1.03	.74	7.98
Cottonwood R. S.	1933 - 1936	3800'	4.58	3.53	1.35	1.32	1.26	.73	.15	.14	.21	.82	1.64	2.37	18.14
Eatons Ranch	1933 - 1937	4000'	2.74	1.56	1.29	1.67	1.19	.61	.06	.25	.27	1.56	2.06	3.17	16.20
J. McDonald Ranch	1933 - 1937	4000'	2.04	1.83	.98	1.17	.54	.67	.24	.15	.35	1.09	1.58	1.31	8.00
Ostners Ranch	1933 - 1935	4100'	.73	.41	.88	.30	1.77	.33	.80	.00	.17	2.78	1.59	3.57	11.68
Prairie	1917 - 1937	4650'	2.61	2.06	2.23	1.45	1.44	1.06	.32	.37	.91	1.32	2.59	2.40	18.76

1/ Data from Weather Bureau and Forest Service records.

Table 6. - Annual maximum discharge of Boise River at Diversion Dam under natural flow conditions and as regulated by Arrowrock Reservoir[1]/

Year	Date	Natural Maximum Discharges	Regulated Maximum Discharges
		c.f.s.	c.f.s.
1825	May 27	7,880	
1896	June 14	35,500	
1897	Apr. 19	29,500	
1898	Apr. 26	6,540	
1899	May 10	19,000	
1900	May 11	11,960	
1901	May 17	12,700	
1902	May 29	8,190	
1903	June 2	16,800	
1904	Apr. 15	19,700	
1905	June 2	6,260	
1906	May 11	8,710	
1907	Apr. 15	17,000	
1908	Apr. 22	10,600	
1909	June 5	16,000	
1910	Apr. 12	12,000	
1911	June 15	15,100	
1912	June 9	15,600	
1913	May 28	13,300	
1914	May 23	11,500	
1915	May 19	6,227	6,227
1916	June 19	13,600	14,830*
1917	June 22	11,400	12,198*
1918	June 24	12,305	12,455*
1919	May 29	15,950	14,300
1920	June 9	7,888	6,988
1921	June 12	17,789	17,439
1922	May 26	17,600	15,920
1923	May 26	14,225	11,075
1924	May 24	3,797	3,597
1925	May 20	15,220	15,220
1926	May 2	5,507	4,507
1927	May 18	24,820	17,220
1928	May 11	19,350	19,200
1929	June 17	7,810	7,460
1930	May 30	8,672	7,322
1931	May 8	5,498	4,498
1932	May 15	13,960	13,810
1933	June 16	12,100	11,950
1934	Apr. 23	4,867	4,317
1935	June 9	9,875	10,025*
1936	Apr. 24	20,450	19,170

*Natural flow increased by draft on reservoir.

1/Records from USGS Water-Supply Papers, Idaho State Department of Reclamation, and Boise Project Board of Control.

Table 7. - Tentative estimates of direct and indirect flood and sedimentation damage, lower Boise River watershed, Idaho, 1919-1938[1/]

	20-yr. total	Annual Average
Direct flood damage:		
Agricultural land and crops	$ 3,800,000	$ 190,000
Roads and bridges	250,000	12,500
Buildings and industrial plants	75,000	3,750
Deposition in Arrowrock Reservoir	350,000	17,500
Deposition in irrigation canals and ditches	400,000	20,000
Unavailability of irrigation water when needed due to deposition in canals	1,000,000	50,000
Total direct flood damage	$ 5,875,000	$ 293,750
Cost of stream channel maintenance	450,000	22,500
Indirect flood damage:		
Reduction of land values because of flood hazard	$ 120,000	$ 6,000
Loss of time and business during floods	100,000	5,000
Total indirect flood damage	$ 220,000	$ 11,000
Total	$ 6,545,000	$ 327,250

1/ Based on estimates supplied by Federal and other governmental agencies, and individuals.

Table 8. - Areas surveyed and survey methods used, Willow Creek Work Unit, Boise River watershed, Idaho, 1938 1/.

Sample Area	Number	Kind of Survey	Acres Surveyed
Woodtick Creek	1	Detailed	1,880
Grouse Creek	2	Reconnaissance	6,873
Corral Creek	3	Spot Sample	
Upper	3a		160
Lower	3b		100
Middle	3c		160
Upper Willow Creek	4	Spot Sample	
Upper	4a		120
Middle	4b		160
Lower	4c		160
Pack Saddle Creek	5	Spot Sample	
Upper	5a		110
Middle	5b		120
Lower	5c		100
Howl Creek	6	Spot Sample	
Upper	6a		100
Middle	6b		110
Lower	6c		120
Total			10,273

1/ See Appendix E for survey specifications.

9a. - Summary of detailed survey of Woodtick Creek, Willow Creek Work Unit, Boise River Watershed, Idaho, 1936.

SOIL TYPE AND DEPTH OF SURFACE SOIL							COVER					SLOPE			EROSION									RECOMMENDED TREATMENT			
		Average Surface Soil Depth by Acres													SHEET				GULLY							
Type	Symbol	6"-12" b	12"+ c	Total Acres	% of Total	Kind	Symbol	Acres Less Than One Perennial Plant Per 100 sq ft	Acres More Than One Perennial Plant Per 100 sq ft	Total Acres	% of Total	Range of Slope in Percentage	Symbol	Total Acres	% of Total	Degree	Symbol	Total Acres	% of Total	Type	Symbol	Total Length in Miles	% of Total	Type	Symbol	Total Acres	% of Total
Moscow Sandy Loam 1/	81	20	828	134	982	52	Grassland (Perennial)	P1		50	50	3	0-19	E	39	2	Accumulation	/	31	2	Shallow	7	8.6	79	Channel Treatment	1	15	1
Brownlee Sandy Loam	82		48		48	3	Sagebrush	P4	143	227	370	20	20-39	F	371	20	Moderate	2	447	24	Deep	7	2.3	21	Contour Seeding	10	695	37
Rainey Sandy Loam	83	275	23		298	16	Browse-Shrub	P5	177	579	756	40	40-59	FF	883	47	Moderately Severe	3	1221	65					Broadcast Seeding	11	74	4
Rainey Gravelly Sandy Loam	863	21			21	1	Annual weeds	P18	674	30	704	37	60-79	G	587	31	Severe	4	181	9					Shrub Planting	12	8	1
Arrowrock Sandy Loam	87	71	187		258	14																			Contour Trenching	13	249	43
Arrowrock Gravelly Sandy Loam	867	1			1	0																			Restricted Grazing only	16	839	44
Woodtick Sandy Loam	88	80	49		129	7																						
Woodtick Gravelly Sandy Loam	868	112			112	6																						
Undifferentiated Recent Alluvium	813			31	31	1																						
TOTAL					1880	100					1880	100			1880	100			1880	100			10.9	100			1880	100

1/ All other soil type names are unofficial, local designations.

9b. - Summary of reconnaissance survey of Grouse Creek, Willow Creek Work Unit, Boise River Watershed, Idaho, 1936.

SOIL TYPE AND DEPTH OF SURFACE SOIL						COVER						SLOPE				SHEET EROSION				RECOMMENDED TREATMENT			
		Average Surface Soil Depth by Acres																					
Type	Symbol	6"-12" b	12"+ c	Total Acres	% of Total	Kind	Symbol	Acres Less Than One Perennial Plant Per 100 sq ft	Acres More Than One Perennial Plant Per 100 sq ft	Total Acres	% of Total	Range of Slope in Percentage	Symbol	Total Acres	% of Total	Degree	Symbol	Total Acres	% of Total	Type	Symbol	Total Acres	% of Total
Moscow Sandy Loam	81	4239	340	4579	66	Sagebrush	P4		1454	1454	21	0-19	E	104	2	Accumulation	/	104	2	Contour Seeding	T10	799	11.6
Brownlee Sandy Loam	82	1927		1927	29	Browse-Shrub	P5	189	2501	2690	39	20-39	F	0	0	Slight	1	151	2	Broadcast Seeding	T11	752	10.9
Rainey Sandy Loam	83	113		113	2	Annual weeds	P18	1312	1266	2578	38	40-59	FF	2219	32	Moderate	2	1340	19	Shrub Planting	T12	337	5.0
Arrowrock Sandy Loam	87	150		150	2	Forest (Ponderosa Pine)	F1	151		151	2	60-79	G	4550	66	Moderately Severe	3	5278	77	Contour Trenching	T13	271	3.9
Undifferentiated Recent Alluvium	813		104	104	1															Restricted Grazing only	T16	4714	68.6
TOTAL				6873	100					6873	100			6873	100			6873	100			6873	100.0

9c. - Summary of spot sample surveys, Willow Creek Work Unit, Boise River Watershed, Idaho, 1936.

						NO TREATMENT			EXCLUSION OF USE			RESEEDING			CONTOUR TRENCHING			LENGTH OF GULLIES TO BE CONTROLLED				
	Tributary	Acres	Sample	Acres	% of Total Tributary	% in Sample	Acres in Sample	% of Three Sample Areas	% in Sample	Acres in Sample	% of Three Sample Areas	% in Sample	Acres in Sample	% of three Sample Areas	% in Sample	Acres in Sample	% of Three Sample Areas	Number	Average Length in Feet	Total Feet of Gully	Feet of Gully Per Acre	Average Ft of Gully per Acre	Miles of Gully in Tributary
			a	160	8.1	5	8.0	1.9	95	152	36.2							7	800	5600	35		
	3	1986	b	100	5.0				95	95	22.6	5	5	1.2				9	600	5400	54	51	19
			c	160	8.1				100	160	38.1							15	700	10500	66		
Percentage of Tributary 3 Requiring Specific Treatment								1.9			96.9			1.2								
			a	120	3.6				100	120	27.3							14	400	5600	46.6		
	4	3360	b	160	4.8				100	160	36.4							6	600	3600	22.5	26.7	17.0
			c	160	4.8				85	136	30.9	15	24	5.4				4	450	1800	11.3		
Percentage of Tributary 4 Requiring Specific Treatment											94.6			5.4								
			a	110	3.3				98	108	32.7	2	2	0.6				1	1800	1800	16.4		
	5	3285	b	120	3.7	5	6.0	1.8	92	110	33.3	2	2	0.6	1	1	0.3	3	700	2100	25.2	25.3	15.7
			c	100	3.0				90	90	27.2	5	5	1.5	5	5	1.5	9	380	3420	34.2		
Percentage of Tributary 5 Requiring Specific Treatment								1.8			93.2			2.7			2.3						
			a	100	11.4				70	70	21.2				30	30	9.1	45	450	20250	202.5		
	6	878	b	110	12.5				90	99	30.0	10	11	3.3				15	600	9000	82.0	94.8	15.8
			c	120	13.7				80	96	29.1	20	24	7.3									
Percentage of Tributary 6 Requiring Specific Treatment											80.3			10.6			9.1						

Table 10. - Acreage by cover types, Willow Creek Work Unit, Boise River Watershed, 1/

Cover Type	Acreage	Percent
Sagebrush	49,902	64
Browse	16,377	21
Annual weeds	10,868	14
Timber	453	1
Total	77,600	100

1/ Based on Map 15 derived from 1930 and 1938 surveys.

Table 11. - Land ownership classes, Willow Creek Work Unit, Boise River Watershed, Idaho, 1938 1/.

Ownership	Number of Acres	Percent of Total
National forest	52,566	68
State of Idaho		
Leased	7,838	10
Not leased	328	*
Elmore County	37	*
Private		
Optioned to Fed. Govt. for purchase	1,709	2
Patented mining claims	164	*
Other	14,958	19
Totals	77,600	100

* Less than 0.5 percent

1/ From County and Forest Service records.

Table 12. - Approximate grazing use on national forest and uncontrolled lands, Willow Creek Work Unit, Boise River Watershed, Idaho, 1938[1/].

Allotment Number	Permittee	Number of stock		Season		No. Days	Animal Months[2/]
		Sheep	Cattle	Open	Close		
1	Kepros Brothers	400		5/1	6/15	46	123
	Frank Kepros	400		4/25	6/15	52	139
2	Wilson Land & Livestock Co.	1200		5/1	6/15	46	368
3	Thomson Brothers	600		5/1	5/31	31	120
4.	Yuba Sheep Co.	800		(5/1	(5/31	62	331
				(10/16	(11/15		
		1100		5/1	6/15	46	337
	Corder, Grover		34	6/1	10/31	153	173
	Beck, J. O.		72	6/1	10/31	153	367
5	Sandlin, Robert		50	5/1	10/31	184	306
	Beck, J. O.		150	6/1	10/31	153	765
6	Lee, Worth S.		60	5/1	10/31	184	368
7	Wolfkiel, A. M.		100	5/1	10/31	184	613
Subtotal - Forest Service administered lands		4500	466				4010
Subtotal - Private and State leased lands not under Forest Service administration		9000	534			216	6864
Grand Total		13,500	1,000				10,874

1/ Data from Forest Service, State and County records, and field survey

2/ Five sheep-months equals one cow-month.

Table 13. Estimated areas requiring various remedial measures, Willow Creek Work Unit, Boise River Watershed, Idaho.

Recommended control measures	Area covered by surveys		Weighted estimate of areas requiring treatment
	Acres	Percent	Acres
Planting contour drill	1,567	15.2	11,808
Planting broadcast	846	8.2	6,368
Shrub planting	338	3.4	2,640
Contour trenching	556	5.4	4,194
Restricted grazing only	6,966	67.8	52,590
Totals	10,273	100.0	77,600

Channel control - Requires 40 siltation dams

Gully control - 200 miles of total of 450 miles requires treatment by shrub planting

Table 14. - Optional work plans and labor requirements, Willow Creek Work Unit, Boise River Watershed, Idaho.

Types of Work		Force Account Labor						CCC Labor						Combination CCC and Force Account Labor									
		Option A		Option B		Option C		Option A		Option B		Option C		Option A Man-Days				Option B Man-Days				Option C Man-Days			
		Work Units	Man-Days	Work Units	Man-Days	Work Units	Man-Days	Work Units	Man-Days	Work Units	Man-Days	Work Units	Man-Days	Work Units	Force Acct.	CCC	Total	Work Units	Force Acct.	CCC	Total	Work Units	Force Acct.	CCC	Total
Restriction of Grazing: involving																									
Livestock control fences	(miles)	25	1,000	25	1,000	120	5,000	25	8,000	25	8,000	120	40,000	25	500	4,000	4,500	25	500	4,000	4,500	25	2,500	20,000	22,500
Revegetation:																									
Contour seeding	(acres)	11,800	5,000	11,800	15,000			11,800	25,000	11,800	75,000			11,800	--	25,000	25,000	11,800	--	75,000	75,000	11,800			
Spot broadcase seeding	(acres)	6,400	2,000	6,400	6,000			6,400	10,000	6,400	30,000			6,400	--	10,000	10,000	6,400	--	30,000	30,000	6,400			
Contour furrows and trenches	(acres)	4,200	5,800	4,200	29,000			4,200	23,200	4,200	116,000			4,200	2,900	11,600	14,500	4,200	14,500	58,000	72,500	4,200			
Shrub planting	(acres)	2,600	3,100	2,600	6,200			2,600	9,300	2,600	18,600			2,600	1,650	4,650	6,300	2,600	3,100	9,300	12,400	2,600			
Mechanical Channel Control:																									
Siltation dams	(number)	40	12,000	60	60,000			40	36,000	40	180,000			40	--	36,000	36,000	60	30,000	90,000	120,000	60			
Service Roads:																									
Construction and improvement	(miles)	90	3,000	90	6,000			90	12,000	90	24,000			90	--	12,000	12,000	90	--	24,000	24,000	90			
Technical Services: 1/																									
Surveys and plans			8,300		9,300		500		10,600		12,600		1,000		3,300	6,000	9,300		4,800	6,000	10,800		400	200	600
Technical Supervision: 2/			5,000		10,000		300		10,000		20,000		600		4,000	2,000	6,000		5,000	10,000	15,000		150	300	450
Administration: 3/			3,600		7,200		1,000		10,000		15,000		3,000		2,000	4,800	6,800		3,600	5,000	8,600		500	1,500	2,000
Total			48,800		149,700		6,800		154,100		499,200		44,600		14,350	116,050	130,400		61,500	311,300	372,800		3,550	22,000	25,550

1/ Technical services includes:
Surveys
Planning
Blueprints
Drafting

2/ Technical supervision includes:
Engineers
Mechanics of all kinds (skilled and unskilled)
Supervision mechanics

3/ Administration includes:
Supervision
Foremen
Clerks

Table 15. - Cost estimates for optional programs by types of labor, Willow Creek Work Unit, Boise River Watershed, Idaho

Cost Items	Force Account - Dollars			CCC - Dollars			Force Account and CCC - Dollars								
							Option A			Option B			Option C		
	Option A	Option B	Option C	Option A	Option B	Option C	Force Account	CCC	Total	Force Account	CCC	Total	Force Account	CCC	Total
Wages, laborers	164,500	616,000	25,000	xxx	xxx	xxx	23,250	xxx	23,250	235,000	xxx	235,000	12,500	xxx	12,500
Transportation	10,000	37,400	1,600	15,000	47,400	1,600	5,000	10,000	15,000	15,000	30,400	45,000	300	1,300	1,600
Housing of labor	12,000	48,000	400	xxx	xxx	xxx	600	xxx	600	4,000	xxx	4,000	150	xxx	150
Equipment	58,000	70,000	3,500	58,000	70,000	3,500	29,000	29,000	58,000	35,000	35,000	70,000	500	3,000	3,500
Materials	50,000	100,000	14,400	50,000	100,000	14,400	25,000	25,000	50,000	60,000	40,000	100,000	2,000	12,400	14,400
Rents	5,000	6,000	2,000	5,000	6,000	2,000	5,000	xxx	5,000	6,000	xxx	6,000	2,000	xxx	2,000
Maintenance of equipment	40,000	85,000	1,500	40,000	85,000	1,500	10,000	30,000	40,000	20,000	65,000	85,000	500	1,000	1,500
Technical services	47,500	52,500	8,500	50,000	60,000	2,000	15,000	22,500	37,500	22,000	34,000	56,000	8,000	1,000	9,000
Technical supervision	40,000	80,000	2,400	80,000	160,000	4,800	10,000	30,000	40,000	50,000	90,000	140,000	1,240	2,400	3,640
Administration	36,000	72,000	9,000	100,000	150,000	30,000	16,000	20,000	36,000	40,000	80,000	120,000	5,000	10,000	15,000
Totals	463,000	1,166,900	68,300	398,000	678,400	59,800	138,850	166,500	305,350	487,000	374,400	861,000	32,190	31,100	63,290

APPENDIX C

Figures

Number	Title
1	Relation of high water stage in Middle Fork of Boise River to daily mean temperatures during the spring run-off period, 1936.
2	Highest, lowest, and average discharges, Boise River below Mores Creek.
3.	Maximum discharges, Boise River 1895-1936.

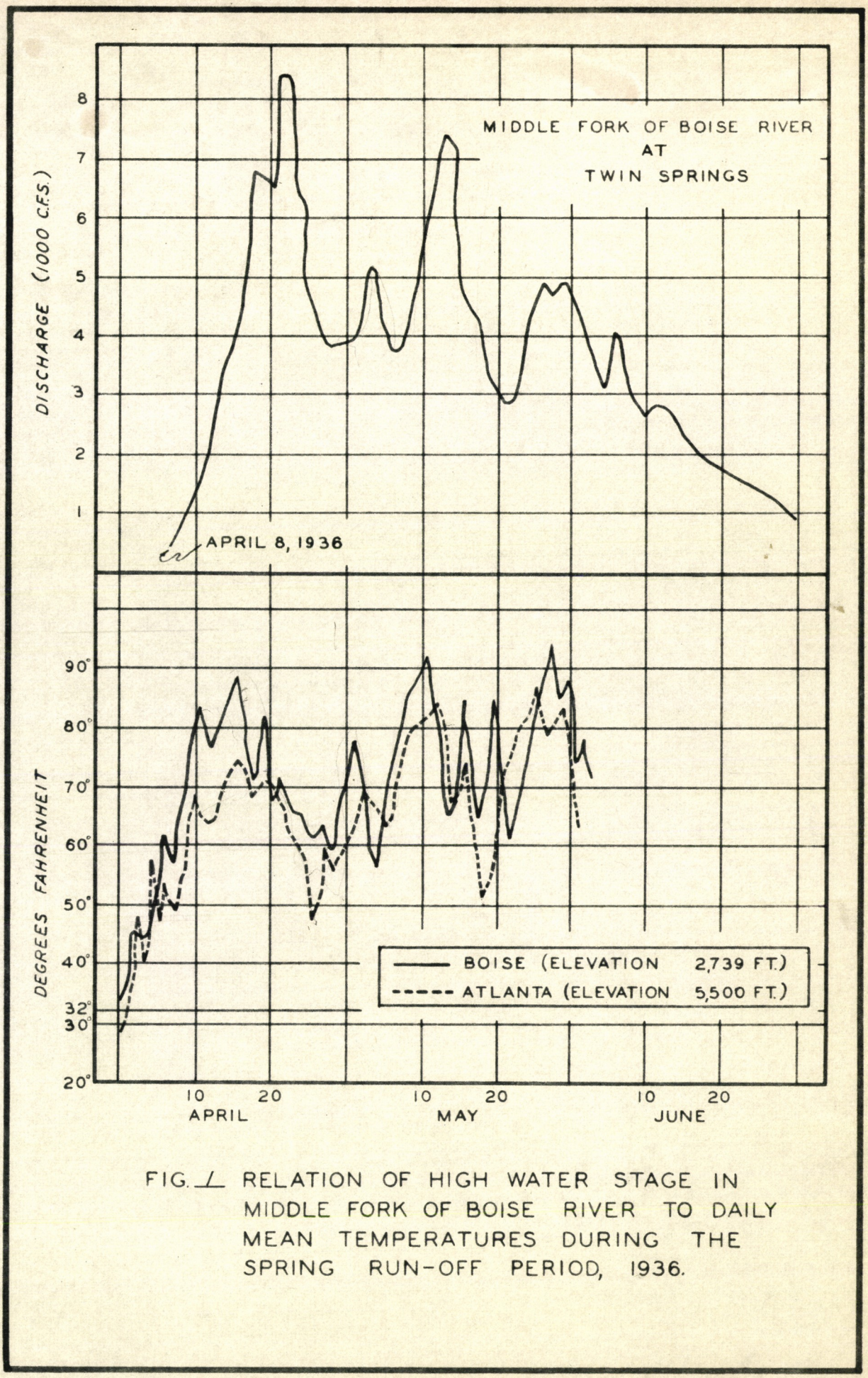


FIG. 1 RELATION OF HIGH WATER STAGE IN MIDDLE FORK OF BOISE RIVER TO DAILY MEAN TEMPERATURES DURING THE SPRING RUN-OFF PERIOD, 1936.

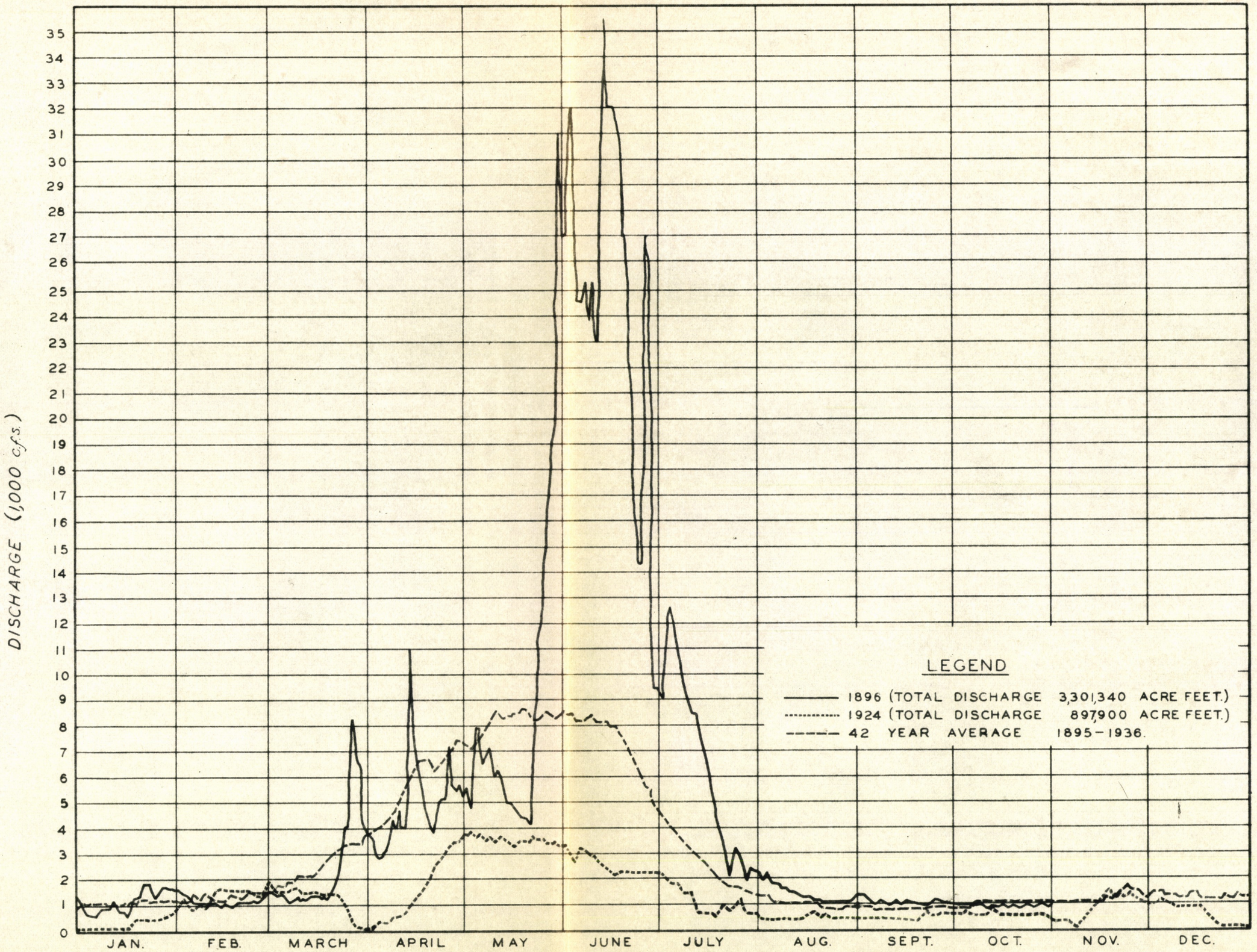


FIG. 2 HIGHEST, LOWEST AND AVERAGE DISCHARGES, BOISE RIVER BELOW MORES CREEK.

DISCHARGES MEASURED NEAR BOISE, IDAHO. FROM 1895 TO 1905.
DISCHARGES MEASURED NEAR HIGHLAND, IDAHO. FROM 1905 TO 1915.
DISCHARGES MEASURED AT DOWLINGS RANCH. FROM 1915 TO 1936.
DISCHARGES OF MORES CREEK ADDED TO BOISE RIVER DISCHARGES. FROM 1915 TO 1936.

SOURCE OF DATA:
U.S.G.S. WATER SUPPLY PAPERS STATE OF IDAHO, BUREAU OF RECLAMATION RECORDS.

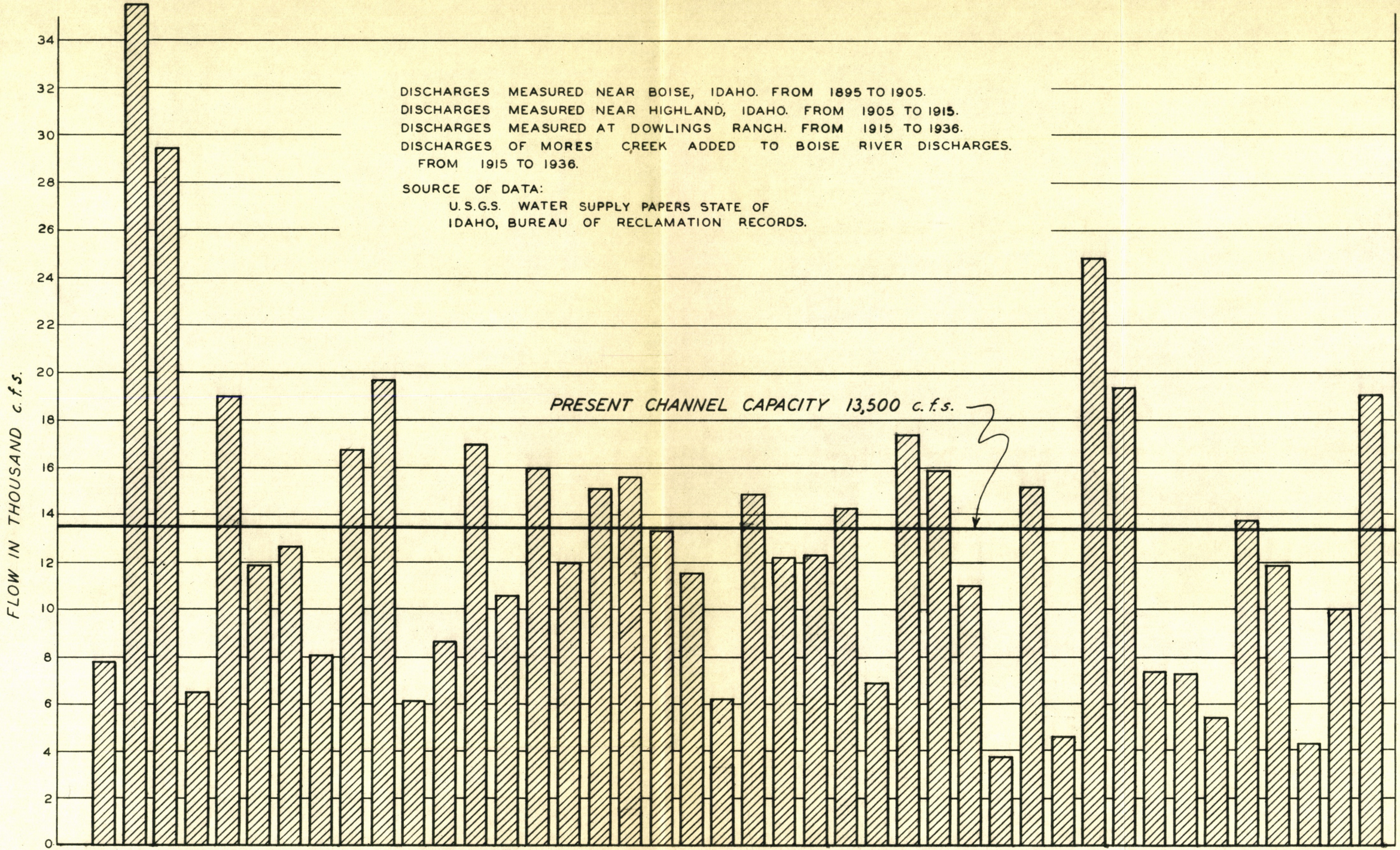
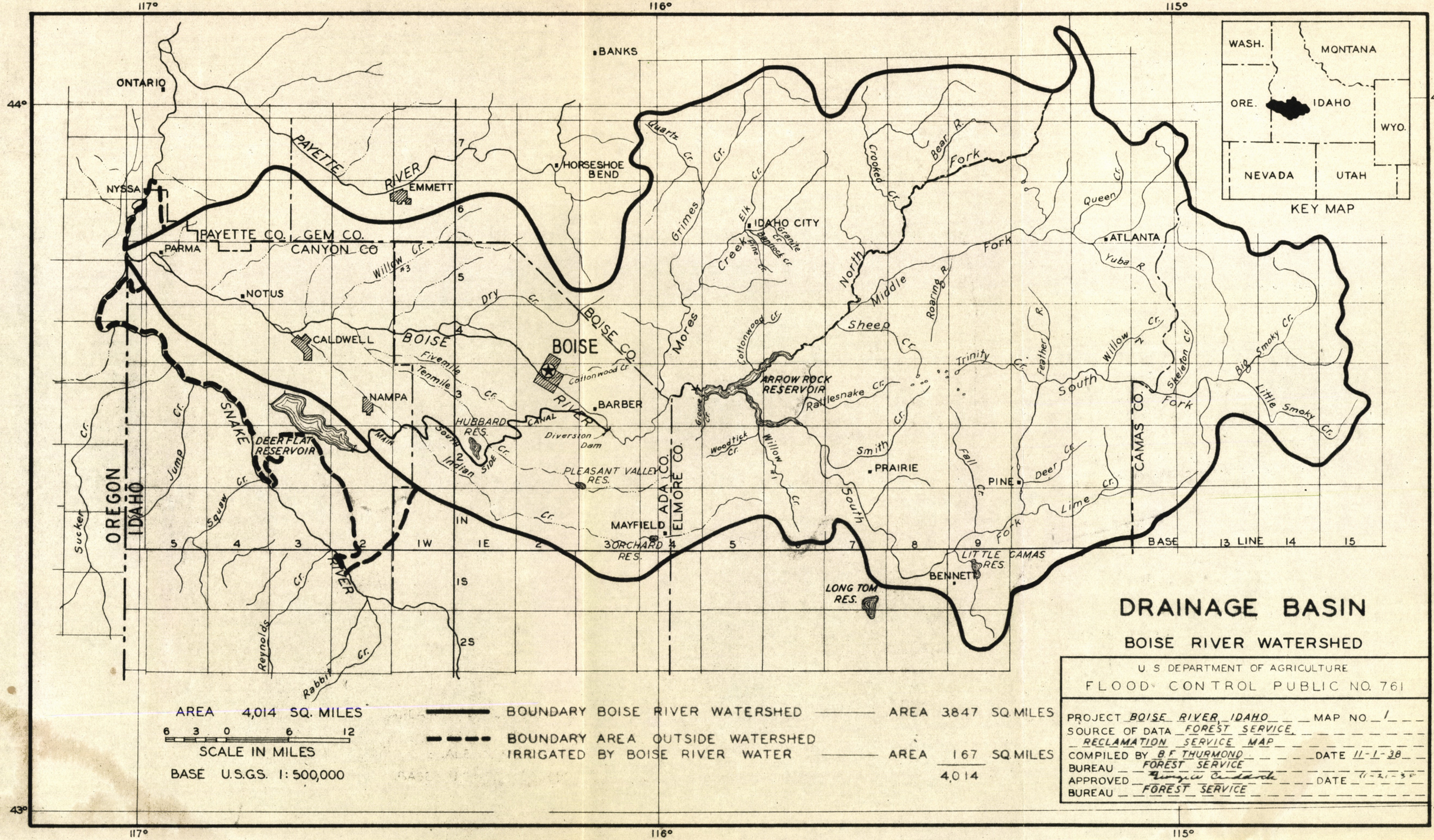


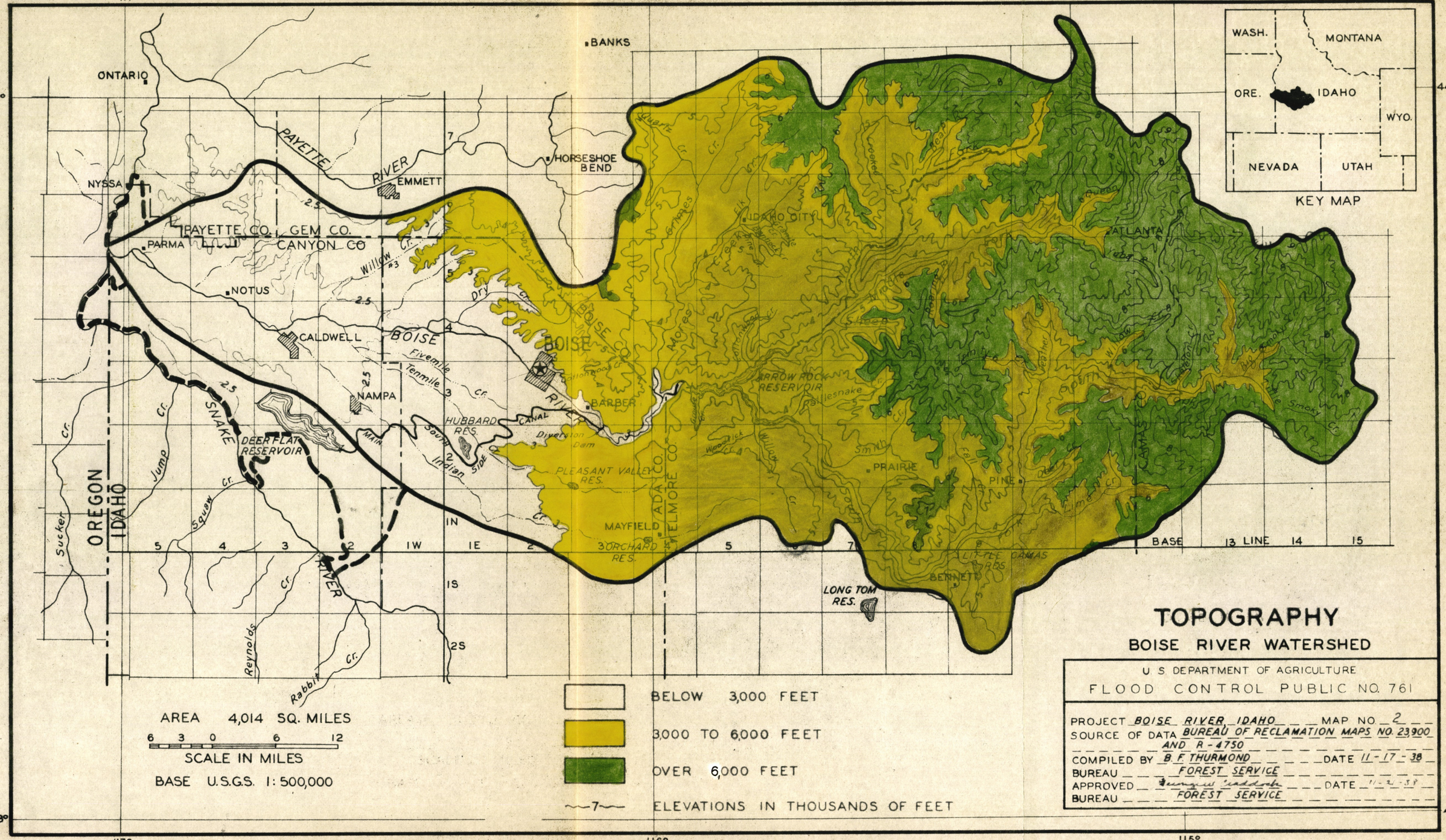
FIG. 3 MAXIMUM DISCHARGES BOISE RIVER 1895 – 1936

APPENDIX D

Maps

Number	Title
1.	Drainage Basin, Boise River Watershed, Idaho.
2.	Topography, Boise River Watershed, Idaho
3.	Generalized Geology, Boise River Watershed, Idaho.
4.	Generalized Erosion, Boise River Watershed, Idaho
5.	Work Unit Areas, Boise River Watershed, Idaho.
6.	Generalized Land Ownership, Boise River Watershed, Idaho.
7.	Generalized Land Use, Boise River Watershed, Idaho.
8.	Generalized Cover Types and Farm Areas, Boise River Watershed, Idaho.
9.	Precipitation Zones, Boise River Watershed, Idaho.
10.	Major Flood Source and Damage Areas, Boise River Watershed, Idaho.
11.	Drainage, Willow Creek Work Unit.
12.	Survey Areas, Willow Creek Work Unit.
13.	Woodtick Creek Detailed Survey, Willow Creek Work Unit.
14.	Grouse Creek Reconnaissance Survey, Willow Creek Work Unit.
15.	Cover Types, Willow Creek Work Unit.
16.	Land Ownership Classes, Willow Creek Work Unit.
17.	Grazing Allotments, Willow Creek Work Unit.
18.	Work Areas and Camp Sites, Willow Creek Work Unit.


117°
116°
115°
44°
43°
BANKS
ONTARIO
NYSSA
EMMETT
HORSESHOE BEND
PARMA
PAYETTE CO.
GEM CO.
CANYON CO
PAYETTE RIVER
NOTUS
CALDWELL
BOISE
BOISE CO.
BOISE
NAMPA
BARBER
ADA CO.
ELMORE CO.
OREGON
IDAHO
SNAKE RIVER
DEER FLAT RESERVOIR
HUBBARD RES.
CANAL
Diversion Dam
PLEASANT VALLEY RES.
MAYFIELD
ORCHARD RES.
ARROW ROCK RESERVOIR
IDAHO CITY
ATLANTA
PRAIRIE
PINE
BENNETT
LITTLE CAMAS RES.
LONG TOM RES.
CAMAS CO.
BASE LINE
Quartz Cr.
Grimes Creek
Elk Cr.
Granite Cr.
Pine Cr.
Dogtrack Cr.
Crooked Cr.
Bear R.
Fork
Queen Cr.
North Fork
Middle Fork
Roaring R.
Yuba R.
Sheep Cr.
Cottonwood Cr.
Mores Cr.
Trinity Cr.
Feather R.
Willow Cr.
Skeleton Cr.
Big Smoky Cr.
Little Smoky Cr.
South Fork
Rattlesnake Cr.
Grouse Cr.
Woodtick Cr.
Willow Cr.
Smith Cr.
Fall Cr.
Deer Cr.
Lime Cr.
Dry Cr.
Willow Cr. #3
Fivemile Cr.
Tenmile Cr.
Main
South Indian Side
Jump Cr.
Squaw Cr.
Sucker Cr.
Reynolds Cr.
Rabbit Cr.
WASH.
MONTANA
ORE.
IDAHO
WYO.
NEVADA
UTAH
KEY MAP
DRAINAGE BASIN
BOISE RIVER WATERSHED
AREA 4,014 SQ. MILES
6 3 0 6 12
SCALE IN MILES
BASE U.S.G.S. 1:500,000
BOUNDARY BOISE RIVER WATERSHED
AREA 3847 SQ MILES
BOUNDARY AREA OUTSIDE WATERSHED IRRIGATED BY BOISE RIVER WATER
AREA 167 SQ MILES
4,014
U S DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761
PROJECT BOISE RIVER, IDAHO MAP NO. 1
SOURCE OF DATA FOREST SERVICE, RECLAMATION SERVICE MAP
COMPILED BY B F THURMOND DATE 11-1-38
BUREAU FOREST SERVICE
APPROVED Regional Forester DATE 11-21-38
BUREAU FOREST SERVICE



TOPOGRAPHY

BOISE RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER IDAHO MAP NO. 2

SOURCE OF DATA BUREAU OF RECLAMATION MAPS NO. 23900 AND R-4750

COMPILED BY B. F. THURMOND DATE 11-17-38

BUREAU FOREST SERVICE

APPROVED Benjamin Goddard DATE 11-2-38

BUREAU FOREST SERVICE

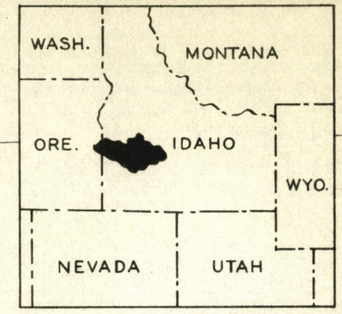
GENERALIZED GEOLOGY

BOISE RIVER WATERSHED

U S DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 3
SOURCE OF DATA ADAPTED FROM GEOLOGY MAP OF UNITED STATES
COMPILED BY F. SCHLOTS DATE 10-27-38
BUREAU SOIL CONSERVATION SERVICE
APPROVED H. Mussman DATE 12-2-38
BUREAU SOIL CONSERVATION SERVICE

KEY MAP



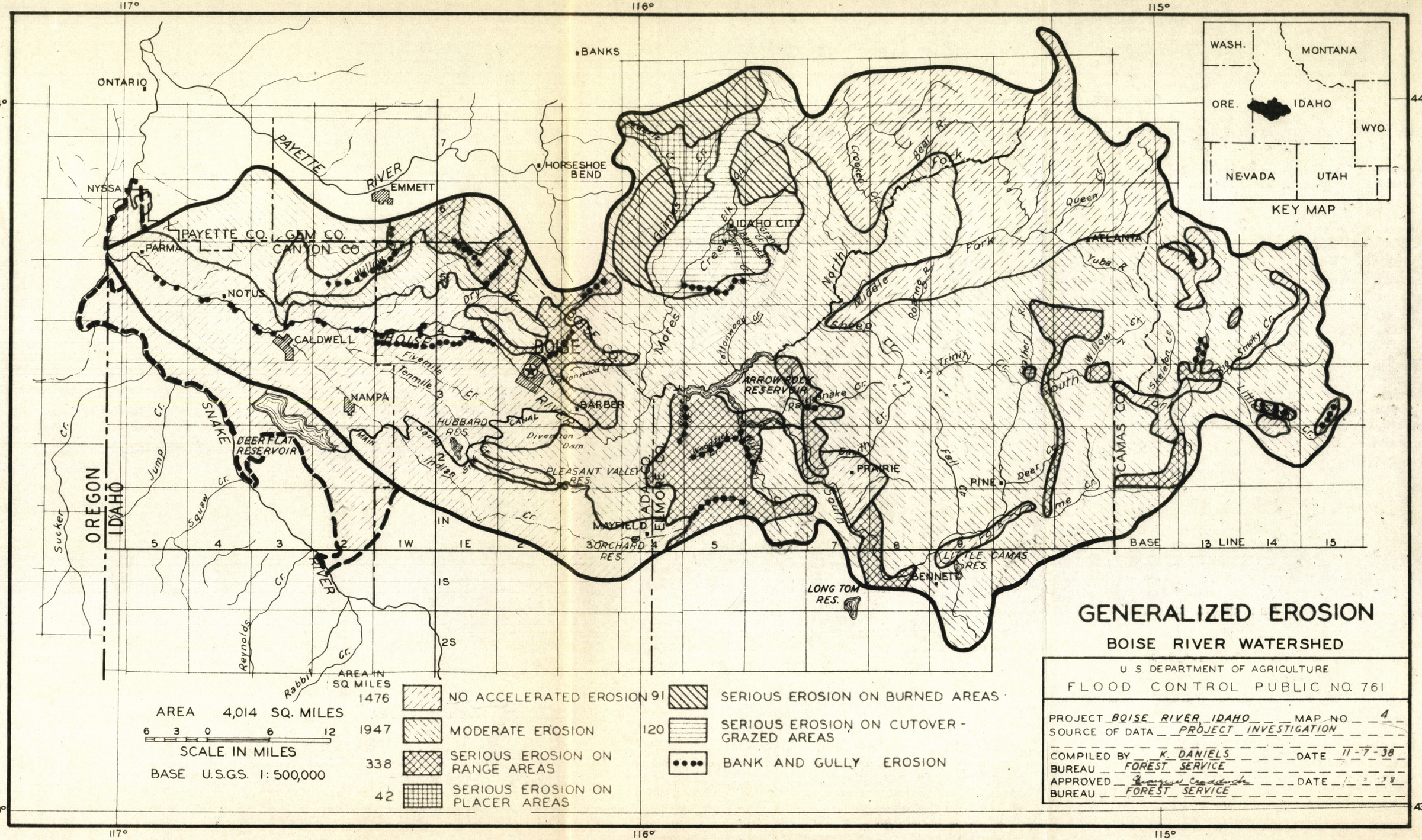
AREA 4,014 SQ. MILES

SCALE IN MILES
6 3 0 6 12

BASE U.S.G.S. 1:500,000

AREA IN SQ. MILES	
2518	GRANITE
412	BASALT (IGNEOUS)
328	QUATERNARY & TERTIARY UNCONSOLIDATED ALLUVIUM
161	RECENT ALLUVIUM
595	TERTIARY CONSOLIDATED CONTINENTAL DEPOSITS

117° 116° 115°
44° 43°



GENERALIZED EROSION

BOISE RIVER WATERSHED

AREA 4,014 SQ. MILES

6 3 0 6 12

SCALE IN MILES

BASE U.S.G.S. 1:500,000

AREA IN SQ MILES		
1476		NO ACCELERATED EROSION
1947		MODERATE EROSION
338		SERIOUS EROSION ON RANGE AREAS
42		SERIOUS EROSION ON PLACER AREAS
91		SERIOUS EROSION ON BURNED AREAS
120		SERIOUS EROSION ON CUTOVER - GRAZED AREAS
		BANK AND GULLY EROSION

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO 4

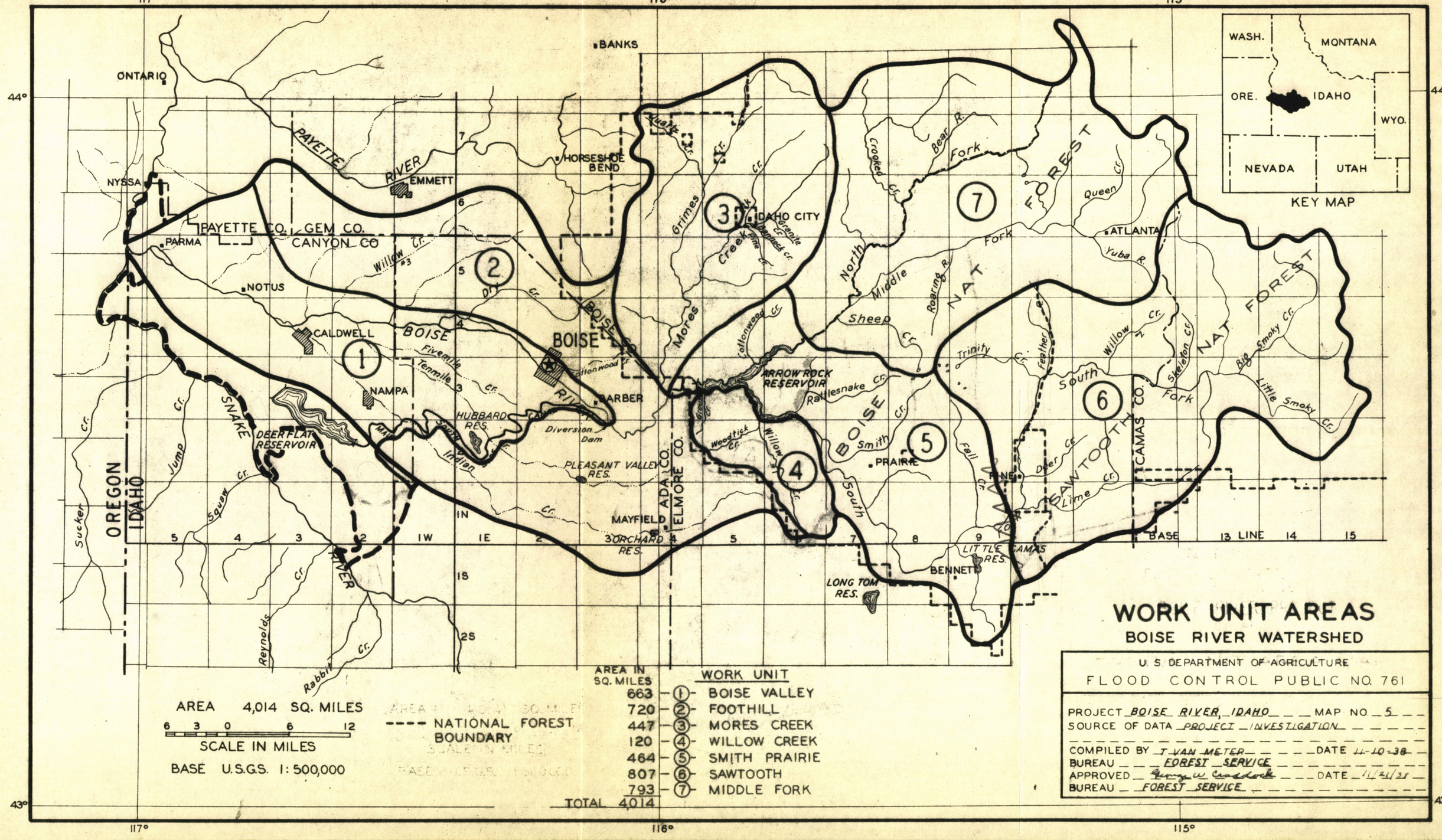
SOURCE OF DATA PROJECT INVESTIGATION

COMPILED BY K. DANIELS DATE 11-7-38

BUREAU FOREST SERVICE

APPROVED Granger Cracraft DATE 1-2-39

BUREAU FOREST SERVICE

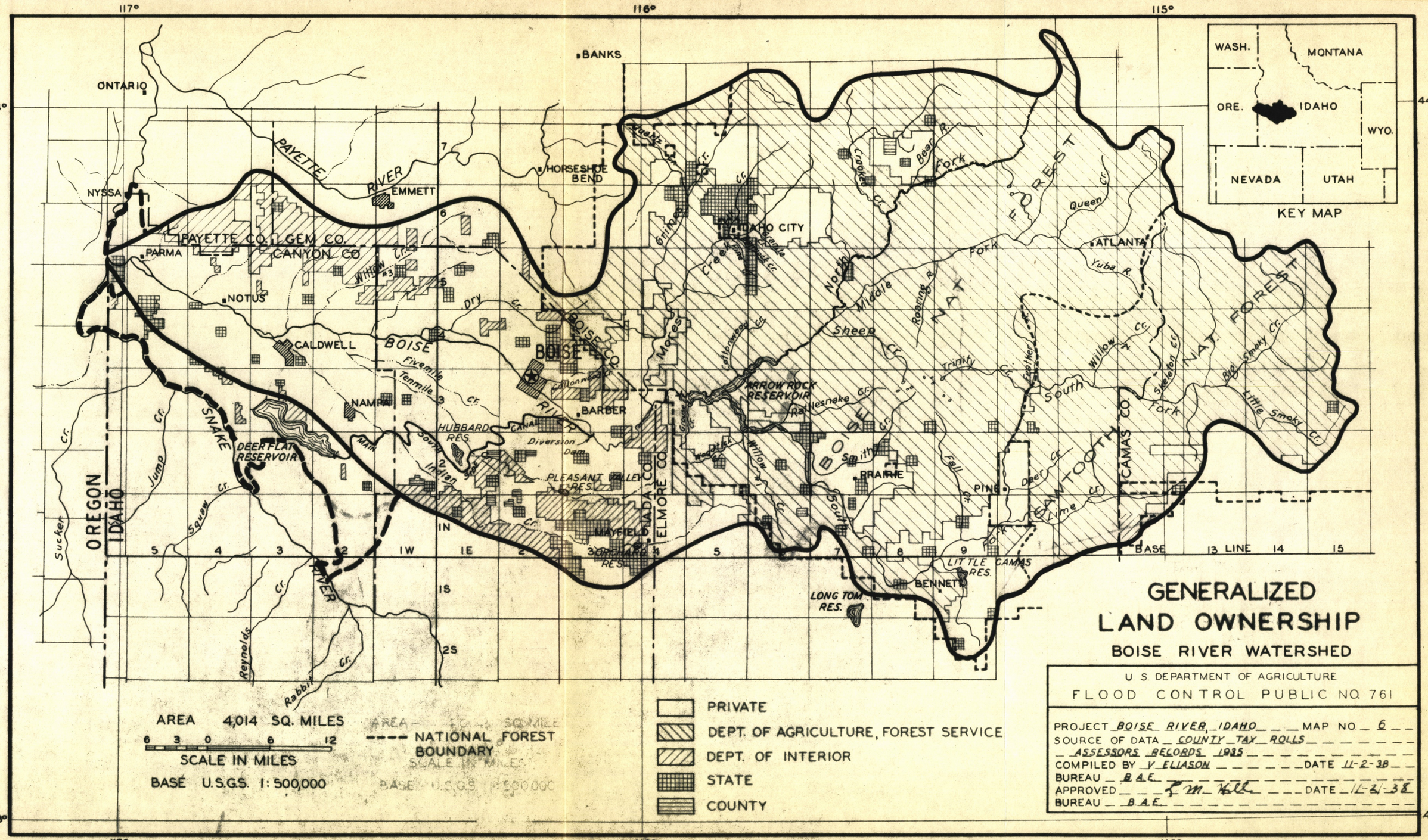


WORK UNIT AREAS
BOISE RIVER WATERSHED

AREA IN SQ. MILES	WORK UNIT
663	(1) - BOISE VALLEY
720	(2) - FOOTHILL
447	(3) - MORES CREEK
120	(4) - WILLOW CREEK
464	(5) - SMITH PRAIRIE
807	(6) - SAWTOOTH
793	(7) - MIDDLE FORK
TOTAL 4,014	

U. S. DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 5
SOURCE OF DATA PROJECT INVESTIGATION
COMPILED BY T VAN METER DATE 11-10-38
BUREAU FOREST SERVICE
APPROVED George W Craddock DATE 11/21/38
BUREAU FOREST SERVICE

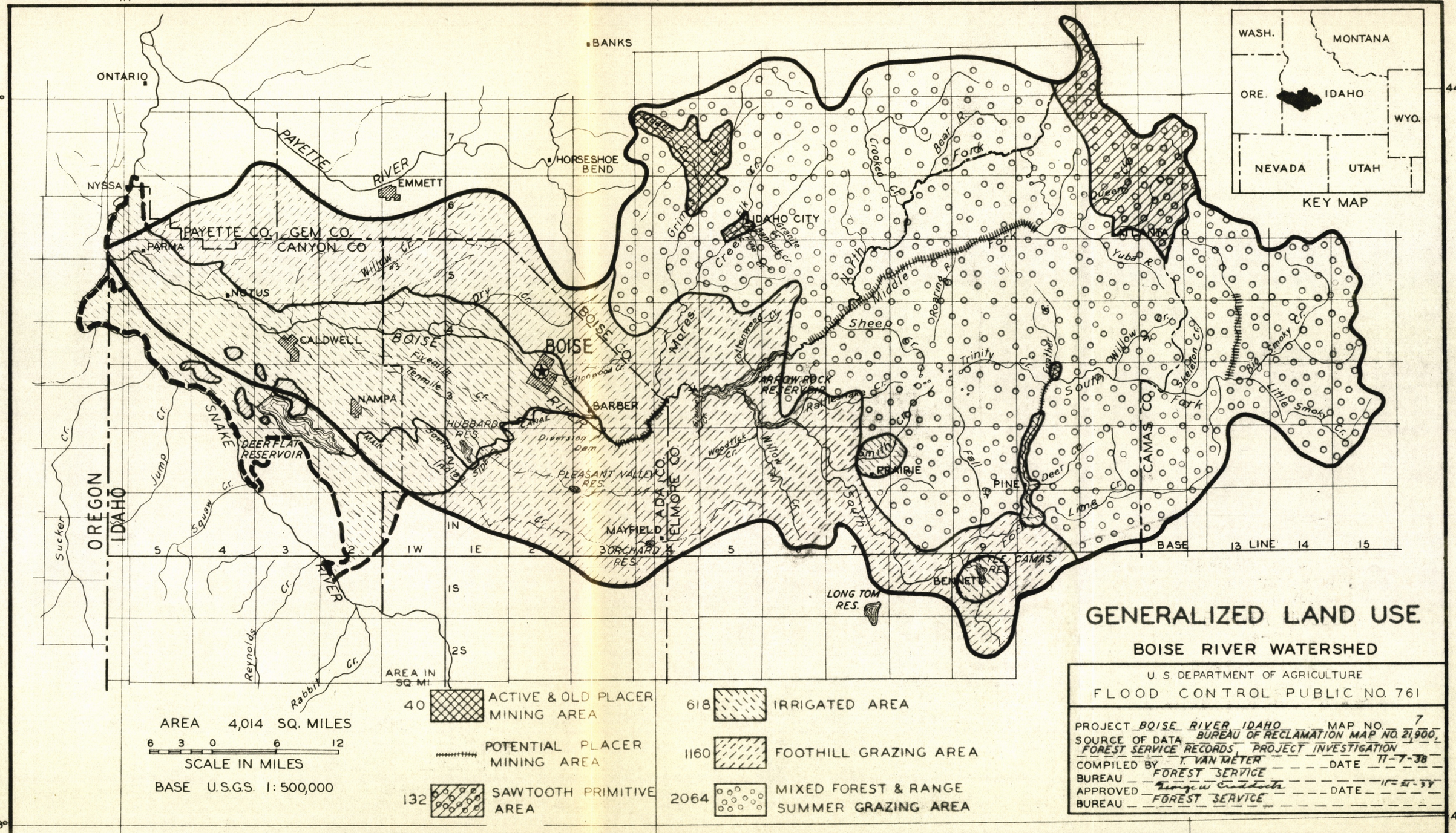


GENERALIZED LAND OWNERSHIP

BOISE RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 6
SOURCE OF DATA COUNTY TAX ROLLS
ASSESSORS RECORDS 1935
COMPILED BY V. ELIASON DATE 11-2-38
BUREAU B.A.E.
APPROVED F. M. Hall DATE 11-2-38
BUREAU B.A.E.



GENERALIZED LAND USE

BOISE RIVER WATERSHED

AREA 4,014 SQ. MILES

6 3 0 6 12

SCALE IN MILES

BASE U.S.G.S. 1:500,000

AREA IN SQ MI.

40 ACTIVE & OLD Pplacer MINING AREA

POTENTIAL PLACER MINING AREA

132 SAWTOOTH PRIMITIVE AREA

618 IRRIGATED AREA

1160 FOOTHILL GRAZING AREA

2064 MIXED FOREST & RANGE SUMMER GRAZING AREA

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER IDAHO MAP NO. 7

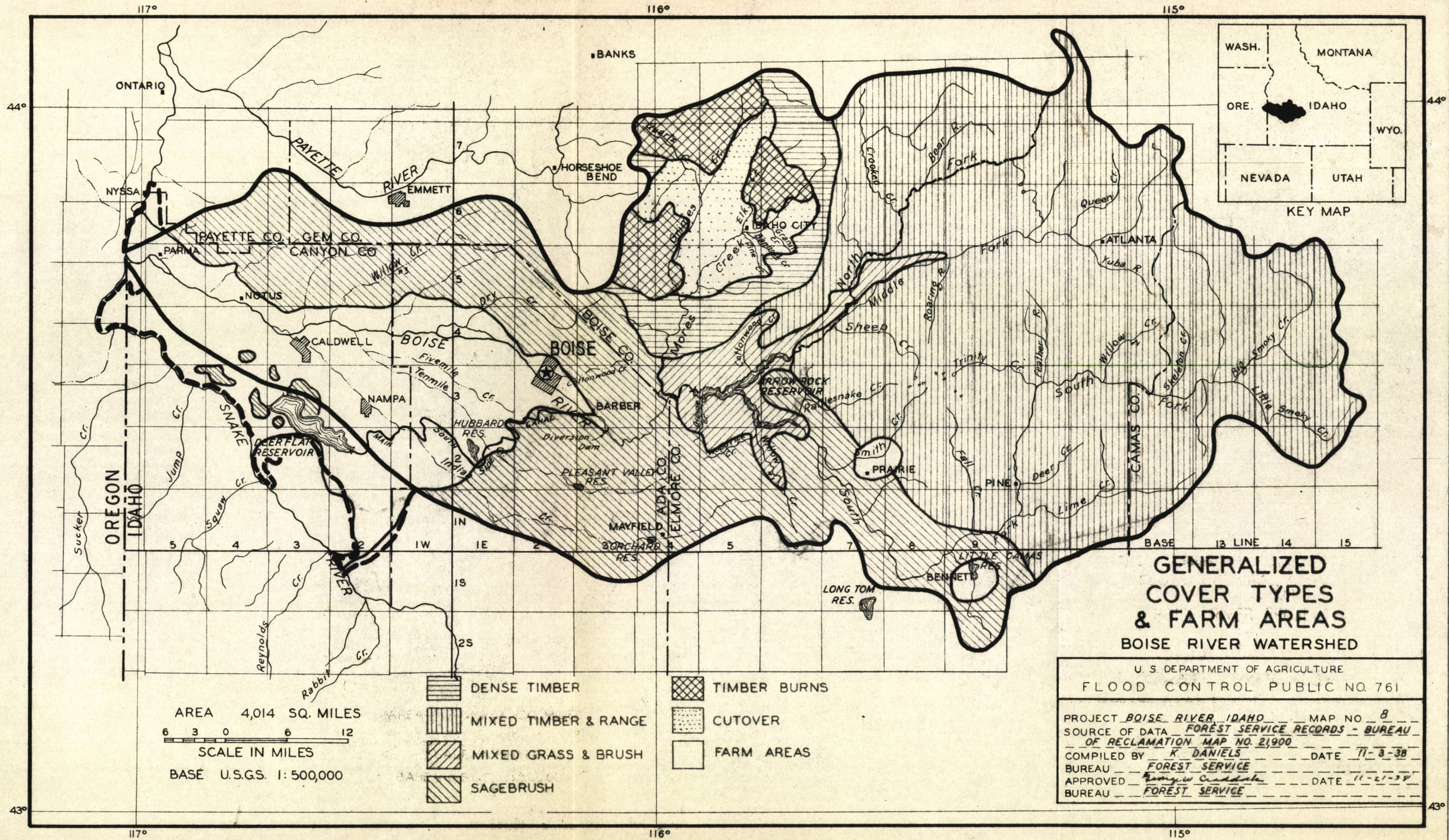
SOURCE OF DATA BUREAU OF RECLAMATION MAP NO. 21,900, FOREST SERVICE RECORDS, PROJECT INVESTIGATION

COMPILED BY T. VAN METER DATE 11-7-38

BUREAU FOREST SERVICE

APPROVED George Craddock DATE 11-21-38

BUREAU FOREST SERVICE



GENERALIZED COVER TYPES & FARM AREAS

BOISE RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 8

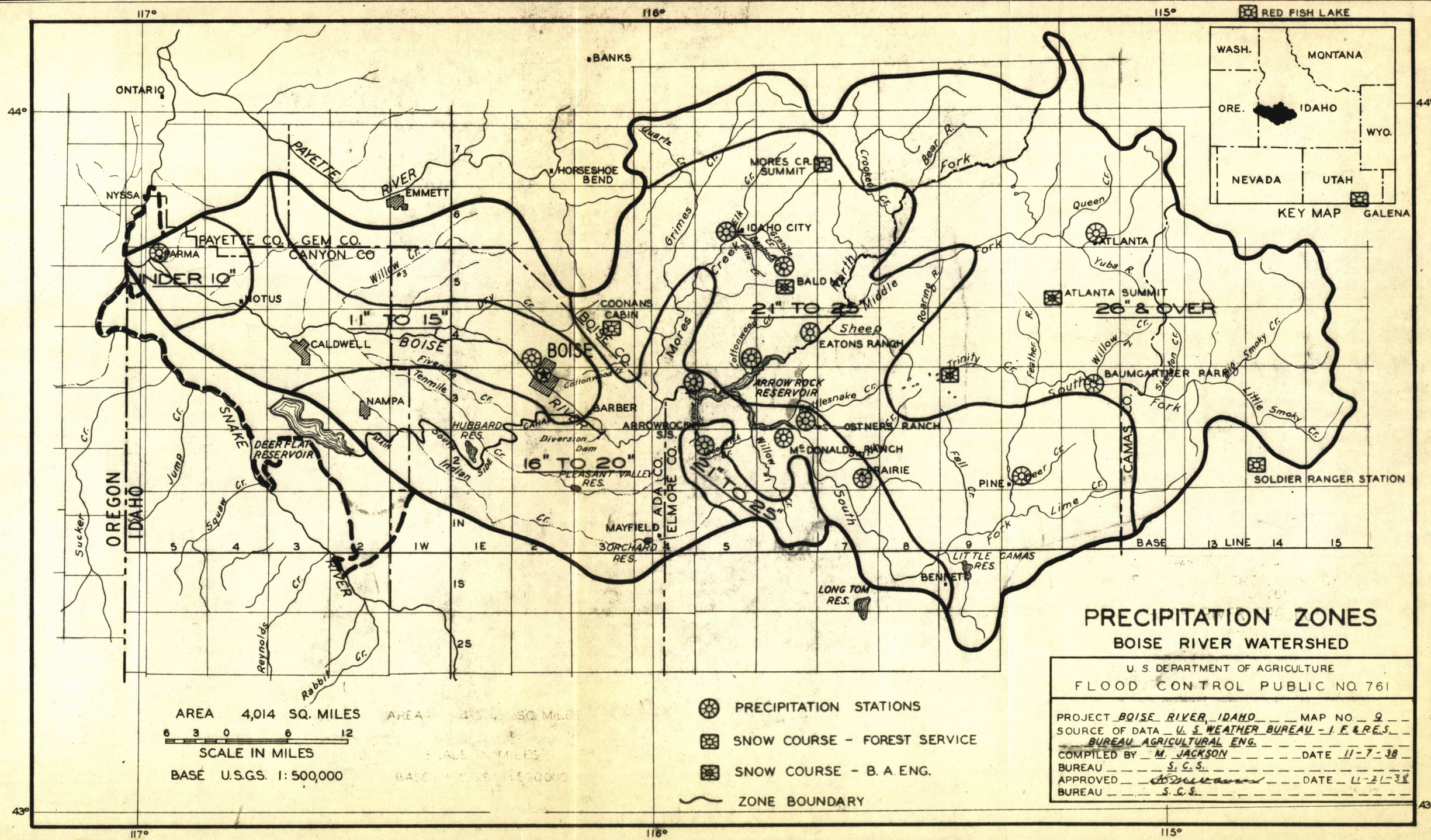
SOURCE OF DATA FOREST SERVICE RECORDS - BUREAU OF RECLAMATION MAP NO. 21,900

COMPILED BY K. DANIELS DATE 11-3-38

BUREAU FOREST SERVICE

APPROVED Henry W. Craddock DATE 11-21-38

BUREAU FOREST SERVICE



PRECIPITATION ZONES

BOISE RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 9

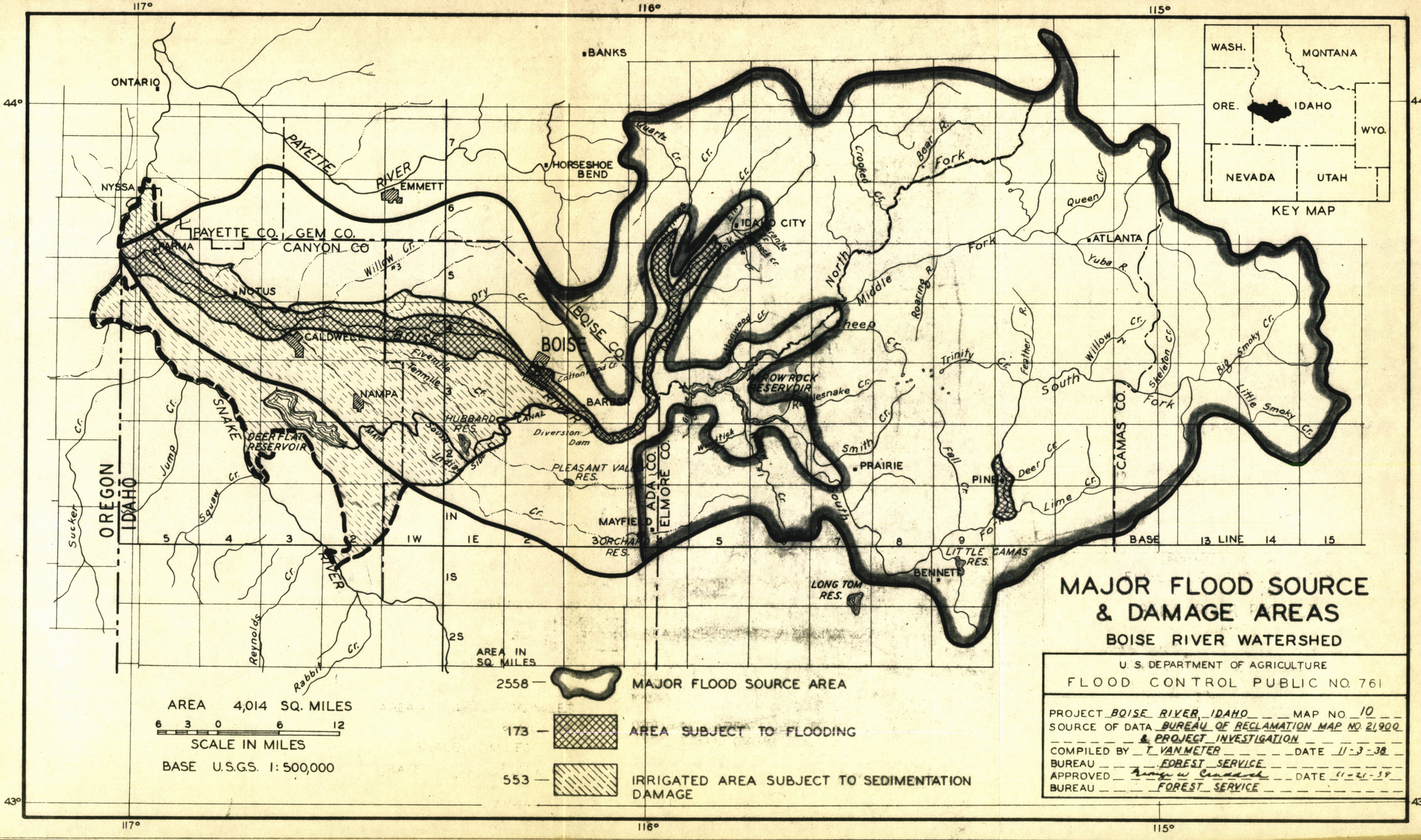
SOURCE OF DATA U. S. WEATHER BUREAU - I. F. & R. E. S. BUREAU AGRICULTURAL ENG.

COMPILED BY M. JACKSON DATE 11-7-38

BUREAU S. C. S.

APPROVED [signature] DATE 11-21-38

BUREAU S. C. S.



MAJOR FLOOD SOURCE & DAMAGE AREAS

BOISE RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 10

SOURCE OF DATA BUREAU OF RECLAMATION MAP NO. 21,900 & PROJECT INVESTIGATION

COMPILED BY T. VAN METER DATE 11-3-38

BUREAU FOREST SERVICE

APPROVED [signature] DATE 11-21-38

BUREAU FOREST SERVICE

116° 50′ 40′ 115°30′

R.4E. R.5E.

COTTONWOOD R.S.

BOISE CO.

ELMORE CO.

ADA CO.

T. 3 N.

T. 2 N.

43° 30′

DAM

ARROWROCK JUNCTION

TO BOISE

ARROWROCK RESERVOIR

ARROWROCK SUB-STA.

THREE PT. MTN.

TO BOISE

Grouse Cr.

Cow Cr.

U.S.L.M. NO. 2

Woodtick Cr.

Bench Cr.

Flat Cr.

Big Fiddler Cr.

Willow Cr.

Coral Cr.

Little Fiddler Cr.

HELLS HOLE

DEVILS HOLE

Bourdo Cr.

Timber Gulch

COUGAR FLAT

PRAIRIE P.O.

Danskin Lake

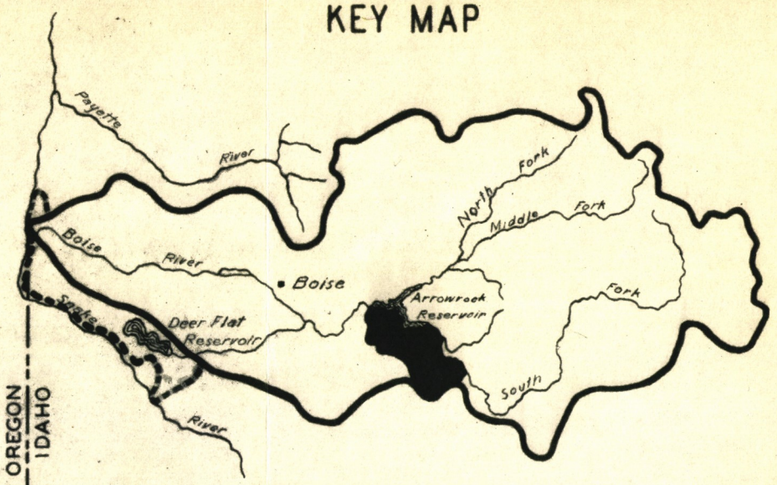
DANSKIN PK.

TO MTN. HOME

NATIONAL FOREST

R.6E. R.7E.

KEY MAP



WORK UNIT BOUNDARY

FOREST BOUNDARY

SCALE IN MILES

0 1 2 4 6

AREA = 77,600 ACRES

DRAINAGE

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 11

SOURCE OF DATA FOREST SERVICE MAP

COMPILED BY G.L. BALLINGER DATE 11-3-38

BUREAU FOREST SERVICE

APPROVED [signature] DATE 11-29-38

BUREAU FOREST SERVICE

116° 50′ 40′ 115°30′

R.4E. R.5E.

COTTONWOOD R.S.

BOISE

BOISE CO.

ARROW ROCK RESERVOIR

NATIONAL FOREST

T. 3 N.

ARROWROCK DAM

ARROWROCK JUNCTION

TO BOISE

ADA CO.

ELMORE CO.

Grouse Cr.

Cow Cr.

U.S.L.M. NO. 2

ARROWROCK SUB-STA.

Woodtick Cr.

Flat Cr.

Big Fiddler Cr.

Willow Cr.

Little Fiddler Cr.

HELLS HOLE

DEVILS HOLE

Bounds Gul.

Timber Gul.

PRAIRIE P.O.

COUGAR FLAT

Danskin Lake

DANSKIN PK.

MTN. HOME

T. 2 N.

43° 30′

TO BOISE

TO MTN. HOME

R.6E. R.7E.

LEGEND

1. WOODTICK CREEK DETAIL SURVEY
2. GROUSE CREEK RECONNAISSANCE SURVEY
3. CORRAL CREEK SAMPLE AREA
   A-UPPER SAMPLE B-MIDDLE SAMPLE C-LOWER SAMPLE
4. UPPER WILLOW CREEK SAMPLE AREA
   A-UPPER SAMPLE B-MIDDLE SAMPLE C-LOWER SAMPLE
5. PACK SADDLE CREEK SAMPLE AREA
   A-UPPER SAMPLE B-MIDDLE SAMPLE C-LOWER SAMPLE
6. HOWL CREEK SAMPLE AREA
   A-UPPER SAMPLE B-MIDDLE SAMPLE C-LOWER SAMPLE

KEY MAP

WORK UNIT BOUNDARY

FOREST BOUNDARY

SCALE IN MILES

0 1 2 4 6

AREA = 77,600 ACRES

SURVEY AREAS

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 12

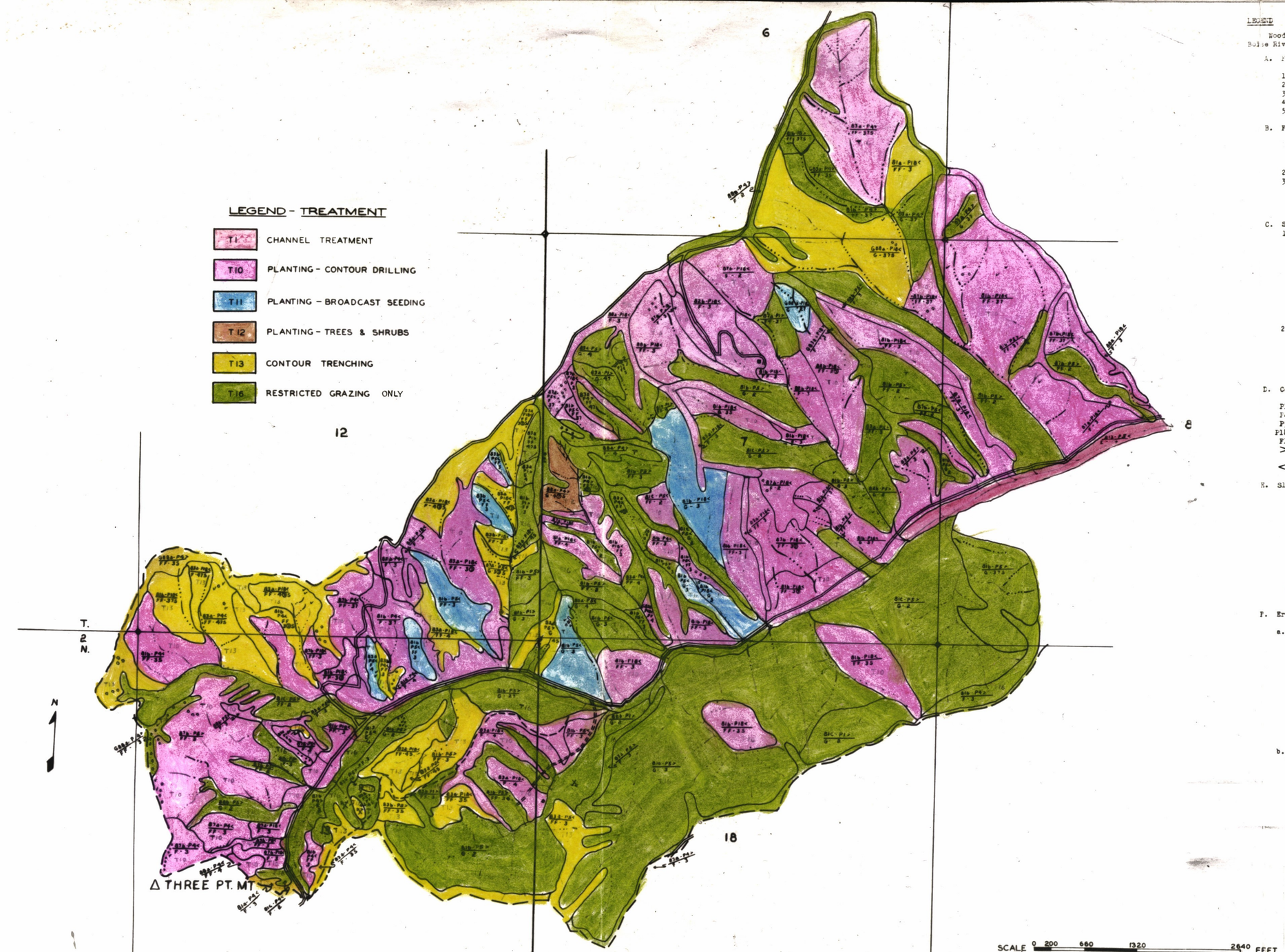
SOURCE OF DATA PROJECT INVESTIGATION

COMPILED BY K. DANIELS & F. SCHLOTS DATE 11-8-38

BUREAU F.S. & S.C.S.

APPROVED [illegible] DATE 11-29-38

BUREAU F.S. & S.C.S.



LEGEND

Woodtick Creek Detail Survey of the Willow Creek Work Unit, Boise River watershed, Idaho.

A. Five factors mapped are as follows:

1. Soil
2. Cover
3. Slope
4. Erosion
5. Treatment

B. Factors occur on map in any of the three following sequences:

1. $\frac{\text{Soil} \mid \text{Cover}}{\text{Slope} \mid \text{Erosion}}$ = treatment
2. Soil - Cover - Slope - Erosion, Treatment
3. Soil
   Cover treatment
   Slope
   Erosion

C. Soils Legend

1. Soils

81	Moscow Sandy Loam
82	Brownlee Sandy Loam
83	Rainey Sandy Loam
G83	Rainey Gravelly Sandy Loam
87	Arrowrock Sandy Loam
88	Woodtick Sandy Loam
G88	Woodtick Gravelly Sandy Loam
813	Sandy Undifferientiated Recent Alluvium

2. Letter following soil symbol designates depth of surface soil remaining

a. Less than six inches of surface soil remaining
b. Six to twelve inches of surface soil
c. Surface soil over twelve inches deep

D. Cover Classification is as follows:

P1	Grassland
P4	Sagebrush
P5	Browse - shrub
P18	Annual weeds and grasses
F1	Forest. Over 25% yellow pine
>	Following cover indicates more than one perennial grass plant per one hundred square feet
<	Following cover indicates less than one perennial grass plant per one hundred square feet

E. Slope Classification:

Symbol	Spread of slope in percent
E	0 - 20
F	20 - 40
FF	40 - 60
G	60 - 80

(No mechanical reseeding or trenching on slopes above 60 percent)

F. Erosion Classified as follows:

a. Sheet Erosion

Class 1	Slight sheet erosion
" 2	Moderate sheet erosion
" 3	Moderate severe sheet erosion
" 32	Moderate severe sheet and moderate sheet erosion occurring in same delineation, but cannot be separated
" 4	Severe sheet erosion
" S	Numerous shoestring gullies or rills 2 to 4 inches deep
"	Accumulations

b. Gully Erosion

1. Shallow gullies designated thus: 7
   (Symbol follows sheet erosion designation)
   (Line and 4 dots designate location of gullies)
2. Deep gullies designated thus: (7)
   (Symbol follows sheet erosion designation)
   (Line and 2 dots designate location of gullies)

3. Slips ((

SCALE 0 200 660 1320 2640 FEET

Area = 1880 Acres

WOODTICK CREEK DETAILED SURVEY

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 13
SOURCE OF DATA
COMPILED BY DANIEL & SCHLOTS DATE 11-18-32
BUREAU F.S. & S.C.S.
APPROVED [illegible] DATE 11-20-32
BUREAU F.S. & S.C.S.

LEGEND

Grouse Creek Reconnaissance Survey of the Willow Creek Work Unit, Boise River Watershed - Idaho

A. Five factors mapped are as follows:

1. Soil
2. Cover
3. Slope
4. Erosion
5. Treatment

B. Factors occur on map in any of the three following sequences:

1. Soil Cover = treatment
   Slope Erosion
2. Soil - Cover - Slope - Erosion, Treatment
3. Soil
   Cover treatment
   Slope
   Erosion

C. Soils Legend

1. Soils

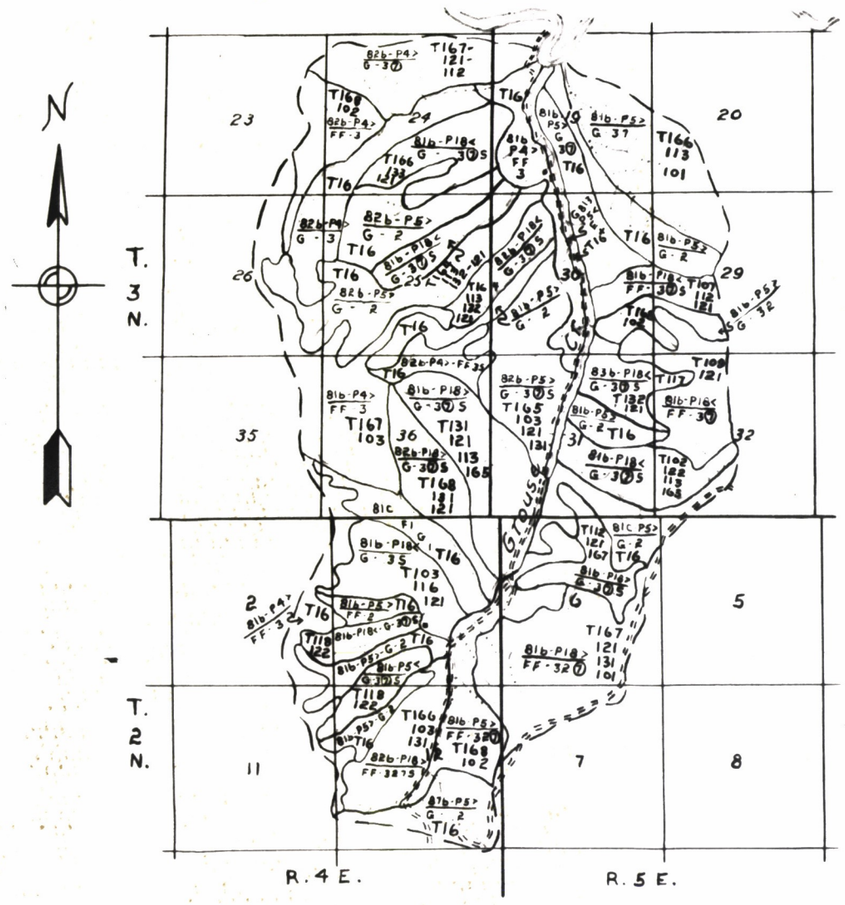
81 Moscow Sandy Loam
82 Brownlee Sandy Loam
83 Rainey Sandy Loam
87 Arrowrock Sandy Loam
813 Sandy Undifferientated Recent Alluvium

2. Letter following soil symbol designates depth of surface soil remaining:

a. Less than six inches of surface soil remaining
b. Six to twelve inches of surface soil
c. Surface soil over twelve inches deep

D. Cover Classification is as follows:

P1 Grassland
P4 Sagebrush
P5 Browse - shrub
P18 Annual weeds and grasses
F1 Forest. Over 25% Yellow Pine
> Following cover indicates more than one perennial grass plant per one hundred square feet
< Following cover indicates less than one perennial grass plant per one hundred square feet



E. Slope Classification

Symbol	Spread of slope in percent
E	0 - 20
F	20 - 40
FF	40 - 60
G	60 - 80

(No mechanical reseeding or trenching on slopes above 60 percent)

F. Erosion Classified as follows:

a. Sheet erosion

Class	1	Slight sheet erosion
"	2	Moderate sheet erosion
"	3	Moderate severe sheet erosion
"	32	Moderate severe sheet & moderate sheet erosion occurring in same delineation, but cannot be separated
"	S	Numerous shoestring gullies or rills 2 to 4 inches deep
"		Accumulations

b. Gully Erosion

Class	7	Shallow gullies
"	7	Deep gullies

G. Recommended treatment

T1	Channel treatment
T 10	Planting - contour drilling
T 11	" - broadcast drilling
T 12	" - trees and shrubs
T 13	Contour trenching
T 16	Restricted grazing only

The numbers following above treatment symbols indicate the estimated percent of delineation to be effected by recommended treatment. A number 1 following treatment indicates 10%; 2 indicates 20%, etc.

GROUSE CREEK RECONNAISSANCE SURVEY

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 14
SOURCE OF DATA PROJECT INVESTIGATION
COMPILED BY K. DANIELS & F SCHLOTS DATE 11-5-38
BUREAU F.S. & S.C.S.
APPROVED [illegible] DATE 11-29-38
BUREAU F.S. & S.C.S.

116° 50′ 40′ 115°30′

R.4E. R.5E.

COTTONWOOD R.S.

BOISE CO.

ARROWROCK RESERVOIR

ARROWROCK DAM

ARROWROCK JUNCTION

TO BOISE

T. 3 N.

ADA CO.

ELMORE CO.

NATIONAL FOREST

T. 3 N.

T. 2 N.

43° 30′

ARROWROCK SUBSTATION

THREE B. MTN

Woodtick Cr.

Big Fiddler Cr.

Little Fiddler Cr.

Deadwood Cr.

Beaver Gulch

COUGAR FLAT

PRAIRIE P.O.

Danskin Lake

DANSKIN PK.

TO MTN. HOME

TO BOISE

R.4E. R.5E. R.6E. R.7E.

BROWSE

SAGEBRUSH

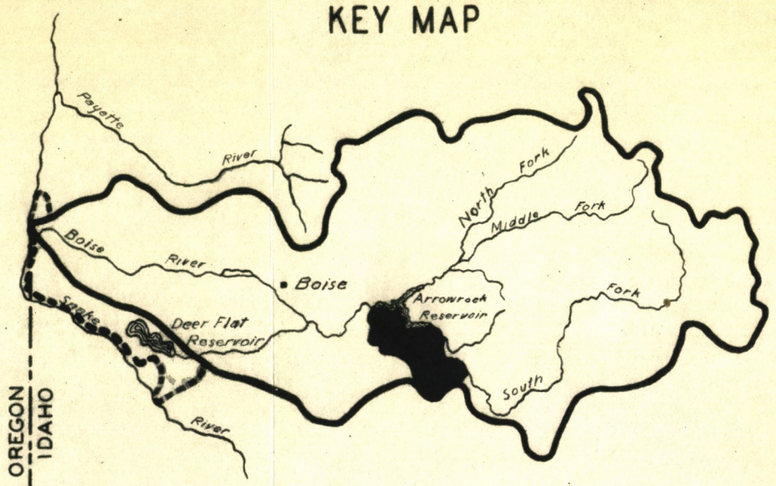
ANNUAL WEEDS

TIMBER

AREA NORTH OF WOODTICK CREEK SURVEYED IN 1938

AREA SOUTH OF WOODTICK CREEK SURVEYED IN 1930

KEY MAP



WORK UNIT BOUNDARY

FOREST BOUNDARY

SCALE IN MILES

0 1 2 4 6

AREA = 77,600 ACRES

COVER TYPES

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 15

SOURCE OF DATA FOREST SERVICE RANGE SURVEY MAP 1930 & FIELD SURVEY 1938.

COMPILED BY K. DANIELS & F. SCHLOTS DATE 1-10-38

BUREAU F.S. & S.C.S.

APPROVED [signature] DATE 4-29-38

BUREAU F.S. & S.C.S.

116° 50′ 40′ 115°30′

R.4E. R.5E.

COTTONWOOD R.S.

BOISE CO.

ARROWROCK RESERVOIR

ARROWROCK DAM

ARROWROCK JUNCTION

TO BOISE

ADA CO.

ELMORE CO.

T. 3 N.

NATIONAL FOREST

T. 2 N.

43° 30′

ARROWROCK SUB-STA.

MINING CLAIMS

TO BOISE

THREE PT. MTN.

Cow Creek

Grouse Creek

Woodtick Cr.

Bear Flat

Scorpion Gulch

U.S.L.M. NO. 2

Fiddler Cr.

Little Fiddler Cr.

Hot Springs

Boundary Cr.

Gulch

COUGAR FLAT

PRAIRIE P.O.

Danskin Creek

DANSKIN PK.

TO MTN. HOME

R.6E. R.7E.

PRIVATE LAND

PRIVATE LAND UNDER OPTION TO FEDERAL GOV'T FOR PURCHASE

STATE LAND

FEDERAL LAND

37 ACRES COUNTY LAND NOT SHOWN

KEY MAP

WORK UNIT BOUNDARY

FOREST BOUNDARY

SCALE IN MILES

0 1 2 4 6

AREA = 77,600 ACRES

LAND OWNERSHIP CLASSES

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 16

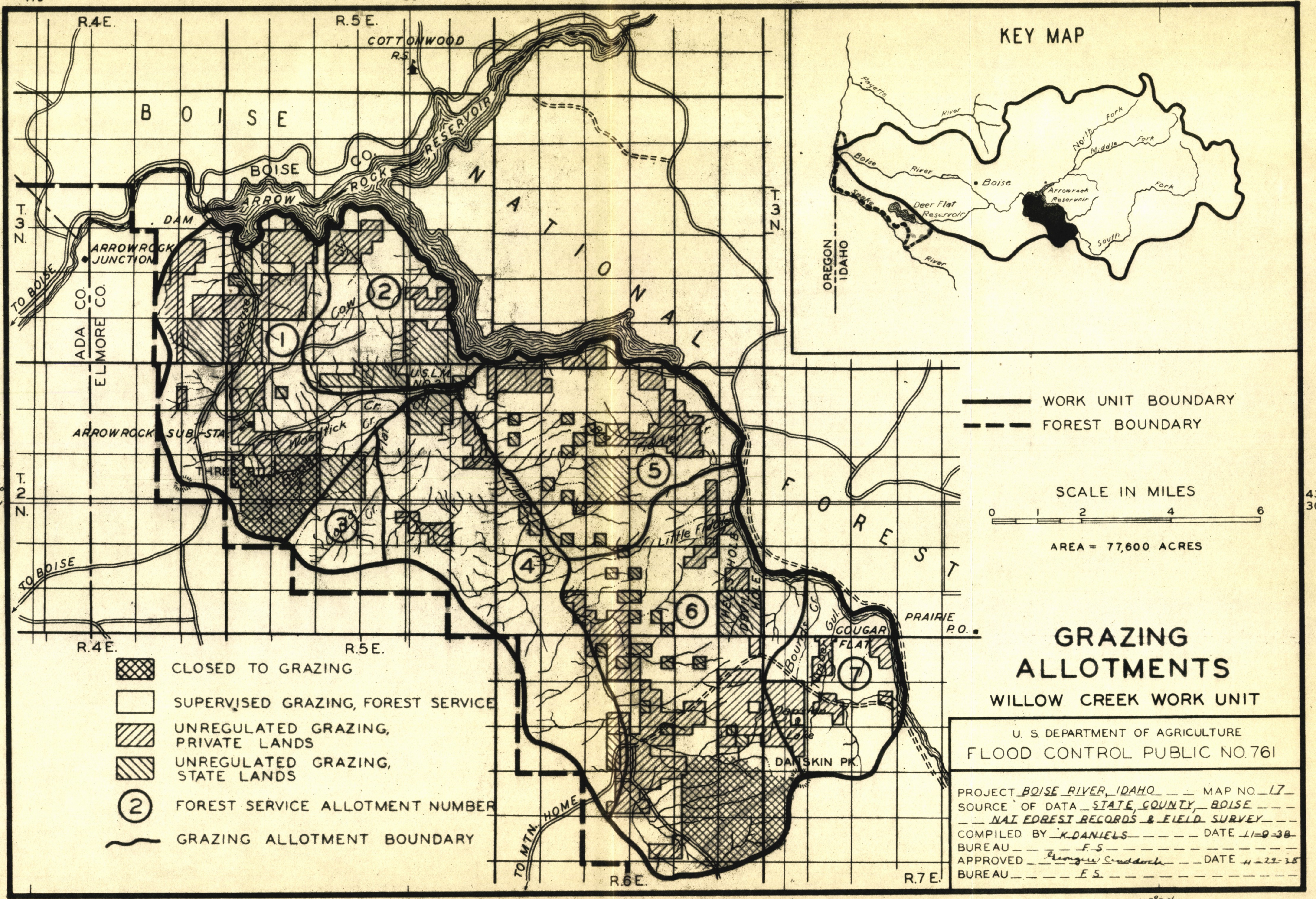
SOURCE OF DATA COUNTY & STATE RECORDS 1938

COMPILED BY K. DANIELS - ELIASON DATE 11-9-38

BUREAU FOREST SERVICE - B.A.E.

APPROVED [illegible] DATE

BUREAU FOREST SERVICE - B.A.E.



GRAZING ALLOTMENTS
WILLOW CREEK WORK UNIT
U. S. DEPARTMENT OF AGRICULTURE
FLOOD CONTROL PUBLIC NO. 761
PROJECT BOISE RIVER, IDAHO MAP NO. 17
SOURCE OF DATA STATE, COUNTY, BOISE NAT FOREST RECORDS & FIELD SURVEY
COMPILED BY K. DANIELS DATE 11-9-38
BUREAU F.S.
APPROVED DATE 11-29-38
BUREAU F.S.
KEY MAP
Payette River
North Fork
Middle Fork
Boise River
Boise
Arrowrock Reservoir
Deer Flat Reservoir
Snake River
South Fork
OREGON
IDAHO
WORK UNIT BOUNDARY
FOREST BOUNDARY
SCALE IN MILES
0 1 2 4 6
AREA = 77,600 ACRES
CLOSED TO GRAZING
SUPERVISED GRAZING, FOREST SERVICE
UNREGULATED GRAZING, PRIVATE LANDS
UNREGULATED GRAZING, STATE LANDS
2 FOREST SERVICE ALLOTMENT NUMBER
GRAZING ALLOTMENT BOUNDARY
116°
50′
40′
115°30′
43° 30′
R.4E.
R.5E.
R.6E.
R.7E.
T.3N.
T.2N.
COTTONWOOD R.S.
BOISE CO.
BOISE NATIONAL FOREST
ARROW ROCK RESERVOIR
DAM
ARROWROCK JUNCTION
TO BOISE
ADA CO.
ELMORE CO.
ARROWROCK SUB-STA.
Cow
Woodtick Cr.
Cr.
U.S.L.M. No. 2
THREE
Little
PRAIRIE P.O.
COUGAR FLAT
Bounds Cr.
DANSKIN PK.
TO MTN. HOME
1
2
3
4
5
6
7

116° 50′ 40′ 115°30′

R.4E. R.5E.

COTTONWOOD R.S.

BOISE CO.

ARROWROCK RESERVOIR

ARROWROCK DAM

ARROWROCK JUNCTION

TO BOISE

ADA CO.

ELMORE CO.

T. 3 N.

NATIONAL FOREST

T. 3 N.

PROPOSED CAMP SITE & WORK AREA NO. 1 AND NO. 2

ARROWROCK SUB-STA.

THREE PT. MTN.

T. 2 N.

43° 30′

TO BOISE

ROAD TO BE IMPROVED AND MADE PASSABLE

PROPOSED CAMP SITE & WORK AREA NO. 2

Little Flat

HELL'S HOLE

DEVIL HOLE

Boulder Cr.

Gul.

COUGAR FLAT

PRAIRIE P.O.

DANSKIN PK.

TO MTN. HOME

R.4E. R.5E. R.6E. R.7E.

① WORK AREA NO. 1 30,600 ACRES

② WORK AREA NO. 2 47,000 ACRES

PRIVATELY OWNED LANDS

FEDERAL & STATE LANDS

① CAMP SITE NO. 1

② CAMP SITE NO. 2

KEY MAP

WORK UNIT BOUNDARY

FOREST BOUNDARY

SCALE IN MILES

0 1 2 4 6

AREA = 77,600 ACRES

WORK AREAS AND CAMP SITES

WILLOW CREEK WORK UNIT

U. S. DEPARTMENT OF AGRICULTURE

FLOOD CONTROL PUBLIC NO. 761

PROJECT BOISE RIVER, IDAHO MAP NO. 18

SOURCE OF DATA FIELD SURVEY

COMPILED BY T. VAN METER F.S. DATE 11-7-38

BUREAU

APPROVED Gregg Condon DATE 11-21-38

BUREAU F.S.

APPENDIX E

SPECIFICATIONS FOR RANGE WORK UNIT SURVEYS

APPENDIX E.

SPECIFICATIONS FOR RANGE WORK UNIT SURVEYS

For

Woodtick Creek Detail Survey
Grouse Creek Reconnaissance Survey
Willow Creek Spot Sample Survey

on

Willow Creek Work Unit, Boise River Watershed, Idaho

GENERAL

Five factors are as follows:

Soil Cover = Treatment
Slope Erosion

A typical symbolic statement shown on the map will be as follows:

87a-P4 - F - 4 - 6

These symbols mean:

8 Soil Texture--Sandy loam
7 Soil Series--Rhyolite, Arrowrock
a Depth of top soil--0 to 6"
P4 Cover type--sage brush with less than one perennial grass plant per 100 square feet
F Percent of Slope--20 to 39 percent
4 Class of erosion--severe erosion
6 Treatment--stream bank planting

Symbols will be grouped and separated by dashes as follows:
Soil texture, Soil series, depth of top soil--dash--cover type--dash--slope class--dash--class of erosion --dash--treatment

Boundaries of composite soil slope erosion type delineated by black line--any one of three factors changing call for new delineation.

Show treatment in green or black at point improvement is to be done to channel; for slope show treatment symbol by delineation.

1. SOIL CLASSIFICATION

a. Texture

(1) Soils of the Willow Creek Work Unit will be classified and mapped according to the following legend:

Texture Symbol	Description
8	Sandy Loam
G	Gravelly
F	Fine Sandy Loam

b. Soil Series

(1) Soils will be mapped and classified according to the following legend:

(a) Granitic
1. Moscow
2. Brownlee
3. Rainey

(b) Rhyolite
7. Arrowrock
8. Woodtick

(c) Recent Alluvium
13. Undifferentiated

(2) Generalized Description of Soil Types:

Moscow Sandy Loam (81)

Moscow Sandy Loam is the most extensive soil type occurring on the Woodtick Creek and Grouse Creek Sample Work Units. Fifty-two percent of the soils mapped are in this classification. Moscow Sandy Loam occurs at a level slightly below the ridge tops. It is the deepest and probably the best adapted soil for range grass production in the area.

The surface soil contains a fair quantity of organic matter. This layer is a loose, friable, dark brown sandy loam which varies from 6 inches to 16 inches in depth, depending somewhat upon slope and the degree of accelerated erosion. The upper subsoil, when dry, is a very slightly compact brown sandy loam. When moist the soil is loose and friable making it diificult to distinguish between the surface and upper subsoil. Because of the loose, friable condition of the upper subsoil it absorbs moisture readily, therefore reducing run-off from rainfall. In case of severe accelerated erosion the upper portion of this subsoil layer is a potential surface and with proper protection will probably support a growth of perennial range grasses. The lower subsoil occurs at a depth of 12 inches to 30 inches. This layer is an open, loose, and friable yellowish-brown granitic material. The open, loose condition permits rapid penetration of moisture.

On north slopes erosion is generally slight. This is probably the result of better moisture conditions which have permitted a cover of perennial browse shrubs and grasses to develop.

Brownlee Sandy Loam (82)

Brownlee Sandy Loam occurs on about three percent of the area mapped on the upper Woodtick Sample Work Unit and 29 percent of the area of the Grouse Creek Watershed Sample Work Unit was classified as this type. Brownlee Sandy Loam occurs on ridge tops or high on the slopes as is the case on the west side of Grouse Greek.

The surface soil of Brownlee Sandy Loam is a loose, friable, dark brown sandy loam varying from 6 inches to 12 inches in depth. The average depth observed was 6 inches to 8 inches. The upper subsoil is a brown, moderately compact, slightly plastic, sandy clay loam, varying from 6 inches to 16 inches in depth. Underlying this material is a compact yellowish-brown sandy clay loam to sandy loam, which breaks down into a single grain mass. Below 16 to 30 inches rotten granitic parent material occurs.

Because of the slightly compact to compact clay loam to sandy clay loam upper subsoil, the penetration of moisture is slower than in a loose, friable material. This probably results in a relatively high run-off, which in the absence of adequate cover makes the surface susceptible to erosion.

Rainey Sandy Loam

The productive level of Rainey Sandy Loam is generally the lowest of any soil type mapped on the Woodtick Creek Sample Area. This soil type is important because it ranks second in extent, occurring on 16 percent of the area. Rainey Sandy Loam occurs on ridge tops and upper steep slopes.

The surface soil of Rainey Sandy Loam is a loose, friable, yellowish-brown sandy loam varying from 2 inches to 8 inches in depth, with a dominant depth of 3 to 4 inches. This layer overlies the parent rock material which is a loose rotten granite.

Moisture penetration of this soil is excessively rapid. The cover is usually very slight, with the dominant types being sagebrush and occasional perennial grasses. Because of the shallow depth of the surface soil and the natural low moisture holding capacity of this type of soil, revegetation will probably be a slow process.

Because of the shallow nature of this soil type on the ridge tops protection from grazing will be necessary to maintain the cover.

Often, on the Rainey Sandy Loam Areas, there is not enough soil material to build contour furrows or diversion ditches.

Rainey Sandy Loam occurs extensively on the east ridges of the Grouse Creek Watershed and on the ridge tops of the Woodtick Creek Sample Work Unit. However, on the Grouse Creek Reconnaissance Survey, this soil type did not occur in large enough bodies to justify delineation. The fact is recognized that this soil type is an important problem on the east side of Grouse Creek. On the west side of Grouse Creek only small scattered areas of Rainey Sandy Loam were noted.

Rainey Gravelly Sandy Loam (G83)

Rainey Gravelly Sandy Loam is a very shallow soil. This type usually occurs on ridge points and in close association with granitic rock outcrops. The surface soil is a brown, gravelly, sandy loam, which varies from 1 inch to about 4 inches in depth. This material overlies rotten granite rock and often bedrock at shallow depths.

Usually the plant cover on this soil type is very sparse. Because of the shallow soil and gravelly condition, perennial grasses become established with difficulty. Complete protection from grazing will be necessary to maintain cover. Shrub plantings of black locust and rose, made by the Intermountain Forest and Range Experiment Station appeared to be making favorable progress toward becoming established on one small area of Rainey Gravelly Sandy Loam. The areas of Rainey Gravelly Sandy Loam are commonly quite small, and numerous areas were too small to delineate. Approximately one percent of the upper Willow Creek Sample Work Unit was classified as this type.

Arrowrock Sandy Loam (87)

Arrowrock Sandy Loam occurs on ridge tops or high on the mountain slopes. This soil is derived from rhyolite of which only remnants remain. This soil occurs on about 14 percent of the area surveyed on the upper Willow Creek Sample Work Unit area. Arrowrock Sandy Loam was not mapped on the reconnaissance survey of the Grouse Creek Sample Work Unit areas as this type usually occurs in rather small areas.

The surface soil of Arrowrock Sandy Loam is a loose, friable, dark brown to slightly grayish-brown, sandy loam, which varies in depth from about 6 inches to 12 inches, with an average depth of about 8 inches. The upper subsoil is a dark brown to grayish-brown, compact, somewhat plastic, sandy clay loam, which ranges from 6 or 12 inches to about 28 inches in depth. The subsoil is a loose, yellowish-brown, somewhat plastic sandy clay loam, which grades into parent material of rotten rhyolite at 40 inches to 60 inches.

This soil appears to be of a somewhat finer texture than the soils derived from granite. Another outstanding characteristic noted was the absence of numerous rills or shallow gullies which were so much in evidence on soils derived from granite, namely the Brownlee and Moscow Sandy Loams. Because of the compact nature of the upper subsoil of Arrowrock Sandy Loam it is expected that rainfall run-off would be high. A correlation between depth of surface soil and stand of perennial cover was noted. Where the surface soil was 6 inches or less in depth there was almost a complete absence of perennial range grasses. Where the surface soil exceeded 6 inches in depth there was still enough remnant stand of perennial range grasses remaining that with proper protection the cover would probably become reestablished.

Arrowrock Gravelly Sandy Loam (G87)

Arrowrock Gravelly Sandy Loam occurs only in small areas, usually too small and scattered to delineate; therefore, many of these areas were identified as gravelly areas within the Arrowrock Sandy Loam delineation.

The surface soil of this soil type is a shallow, brown, gravelly, sandy loam less than 6 inches in depth. The average depth is 3 to 4 inches. The upper subsoil is a brown, compact, gravelly, sandy loam. The gravel is dominantly angular rhyolitic fragments. This layer varies from 8 to 12 inches in depth. The lower subsoil is a yellowish-brown, friable, gravelly, sandy loam with numerous fragments of rhyolite and rotten parent rhyolitic material.

Because of the shallow surface soil and its gravelly nature, reseeding will probably be the most successful means of treatment in an attempt to reestablish vegetation to retard run-off.

Woodtick Sandy Loam (88)

Woodtick Sandy Loam is a shallow soil derived from rhyolite and occurs on ridge tops as well as high on the mountain slopes. On the detailed survey of the upper Woodtick Creek Sample Work Unit Area, seven percent of the area was classified as Woodtick Sandy Loam.

The surface soil of Woodtick Sandy Loam was found to vary from 6 inches to 8 inches in depth. This horizon is a brown, friable, sandy loam which immediately overlies the parent material of rotten rhyolite.

Because of the fact that a relatively deep surface soil exists on Woodtick Sandy Loam, a cover of perennial range grasses may be re-established, but to maintain a cover and retard run-off protection from grazing will be necessary.

Woodtick Gravelly Sandy Loam (G88)

Woodtick Gravelly Sandy Loam is a very shallow soil derived from rhyolite. This soil type occurs on six percent of the area mapped on the upper Woodtick Sample Work Unit area.

The surface soil is a brown, gravelly, sandy loam, averaging four to six inches in depth. This material immediately overlies rotten rhyolitic material. The gravel occurring in this soil is generally angular rhyolite 2 to 3 inches in diameter. The soil type occurs in the immediate vicinity of rock outcrops.

Because of the shallow nature of the surface soil and the loose gravelly condition of the parent material, occasional shrub and tree plantings along with reseeding would probably prove to be the most satisfactory means of stablizing the soil. Areas of this nature will require protection from grazing to maintain any cover that might be reestablished.

Undifferentiated Recent Alluvium (813)

The Undifferentiated Recent Alluvium occurs on about 1 percent of the areas mapped. This soil material occurs in stream bottoms as silt, sand, gravel, and boulders, moved into the bottom lands from the higher lands. Along Woodtick Creek dominantly fine materials were observed, while along Grouse Creek gravel and boulders 1 foot to 3 feet in diameter were very much in evidence.

This soil material is of an extremely heterogenous nature as to source and mode of deposition; therefore it has no definite profile that can be accurately described. Stream channel treatment in the form of channel plantings and structures will probably be necessary to slow the momentum of the water and to stabilize the soil material.

(3) Soil Type Profile Descriptions:

(a) Arrowrock Sandy Loam (87)

Horizon	Depth	Description
A	0 - 2"	A friable dark brown sandy loam.
B_1	2" - 12"	A medium compact slightly plastic dark, brown sandy clay loam. Fine crumb structure. Porous.
B_2	12" - 24"	A very compact, hard sandy clay loam. Crumb structure. Porous.
C	---- 24"	A slightly cemented yellowish-brown sandy material that readily breaks down into a single grain mass.

(b) Arrowrock Sandy Loam (87)
(Derived from rhyolite

Horizon	Depth	Description
A	0 - 8"	A friable grayish-brown sandy loam. (Moist) Finely granular structure. About 1 - 2 mm in diameter.
B_1	8" - 12"	A somewhat compact, lighter grayish-brown sandy clay loam. Porous to vesicular structure. Fine crumb structure.
B_2	12" - 28"	A highly compact grayish-brown plastic sandy clay loam. Porous crumb structure.
C	-----28"	A loose yellowish-brown somewhat sandy plastic clay loam. Porous. Crumb structure. Parent material rhyolite.

(c) Rainey Coarse Sand (C83)
(Derived from granite)

Horizon	Depth	Description
A	Entirely lost	
B	Absent	
C	A coarse, loose granitic material	

(d) Woodtick Sandy Loam (88)
(A - C on rhyolite)

Horizon	Depth	Description
A	0 - 6"	A friable granular sandy loam with chips of rhyolite throughout horizon.
C	----6"	Rhyolite chips and sand.

(e) Woodtick gravelly sandy loam (G88)

Horizon	Depth	Description
A	0 - 6"	A brown, friable, gravelly, sandy loam. (Gravel is angular rhyolite 2" - 3" in diameter).
C	----8"	Parent material of rotten rhyolite

(f) Rainey Coarse Sandy Loam (C83)
(Derived from granite)

Horizon	Depth	Description
A	0 - 6"	A friable dark yellowish-brown coarse sandy loam. Occasionally sandy loam texture obtained. Single grain structure.
C	----6"	Rotten granitic material.

(g) Moscow Sandy Loam (81)
(Granitic derived) South East Slope

Horizon	Depth	Description
A	0 - 8"	A friable medium brown sandy loam. Single grain structure.
B	8" - 20"	A light yellowish-brown sandy loam with single grain structure. Friable with tendency toward being loose.
C	-----20"	A lighter yellowish-brown sandy loam. Loose and friable. Single grain.

(h) Moscow Sandy Loam (81)
(Derived from Granite)

Horizon	Depth	Description
A	0 - 14"	A friable dark brown sandy loam with some coarse granitic sandy material. Single grain structure. Open.
B	14" - 30"	A very slightly compact brown sandy loam. Crumb structure. Crumbs easily crushed indicating very slight development.
C	---- 30"	A loose friable yellowish-brown rotten granitic material.

(i) Moscow Sandy Loam (81)
(Derived from granite)

Horizon	Depth	Description
A	0 - 4"	A friable single-grained brown sandy loam.
B	4" - 18"	A very slightly compact brown sandy loam with somewhat more silt than A horizon. Slightly crumb structure which breaks readily to almost single grains.
C	----18"	A loose friable yellowish-brown loam high in rotten granitic material.

(j) Rainey Sandy Loam (830)
(Derived from granitic material)

Horizon	Depth	Description
A	0 - 2"	A friable yellowish-brown sandy loam.
C	----2"	Rotten granitic material

Slope: 25 percent

(k) Moscow Sandy Loam (81)
(Derived from granitic material)

Horizon	Depth	Description
A	0 - 3"	A friable medium brown sandy loam.
B	3" - 12"	A slightly compact light brown sandy clay loam. Vesicular.
C	----12"	A brownish-yellow sandy clay loam. Rather friable. When dry has somewhat reddish crust.

(l) Moscow Fine Sandy Loam (f81)
(Derived from granite)

Horizon	Depth	Description
A	0 - 6"	A dark brown very fine sandy loam carrying occasional coarse granitic sand.
B_1	6" - 18"	A dark brown sandy loam. Somewhat compact breaking down into a friable mass. Crumb structure. Occasional granitic fragments scattered through horizon.
B_2	18" - 30"	A yellowish-brown sandy loam. Very slightly compact. Crumb structure which breaks down into a friable mass.
C	-----30"	A loose friable lighter yellowish-brown sandy loam, with occasional mottling gray and red.

c. Depth of top soil.
(1) The range in depth of top soil is classed and mapped as follows:

Symbol	Description
a	0 to 3 inches
b	3.1 to 6 inches
c	6.1 to 12 inches
d	over 12 inches

2. COVER CLASSIFICATION

a. Range types to be recognized, delineated and mapped on the Woodtick Creek and Bender Creek areas. Standard Western Range Survey Symbols to be used.

Pl. Grassland
(a) To include the bunchgrass range, typical of north and east exposures, where perennial grasses are in association with perennial forbs and a limited amount of browse. Perennial grasses dominant.

Dominant Species:

Grasses

Agropyron spicatum
Festuca idahoensis

Weeds

Eriogonum heracleoides
Balsamorhiza sagittata
Lupinus sp.

Browse

Prunus melanocarpa
Acer (Mountain maple)
Opulaster
Artemisia tridentata
Chrysothamnus (Rabbitbrush)
Purshia tridentata

(b) To include bunchgrass range on south and west exposures where no perennial associates occur. Some annual grasses and weeds may be found between the bunch forming grasses. A few remnants of sagebrush may occur in this type. Before depletion (fire) somewhat more sagebrush probably occurred.

P-4. Sagebrush

To include areas where Artemisia tridentata forms a natural overstory. Very intermittent overstories under P16)

(a) Perennial grasses and weed understory - usually Agropyron spicatum.
(b) Annual understory - grass and/or weed.

P-5. Browse - Shrub

Type delineated on basis of browse overstory.

Typical browse plants:

Prunus melanocarpa
Amelanchier alnifolia
Ceanothus
Acer (Mountain maple)
Opulaster
Symphoricarpos

(a) Perennial understory similar to P1a type.
(b) Annual understory similar to P18a or P18b.

P-18. Annuals

To include areas where predominant vegetation is annual.

(a) Annual grass - Downy chess (Bromus tectorum)
(b) Annual weeds - Gayophytum
Lactuca
Madia

F1. Forest cover 25 percent Ponderosa pine.

3. EROSION CLASSIFICATION

a. Erosion is classified and mapped as follows:

(1) Sheet Erosion

(a) Class 1. Slight erosion, less than 25 percent of top soil removed.

(b) Class 2. Moderate erosion, 25.1 percent to 50 percent of top soil removed.

(c) Class 3. Moderate severe erosion, 50.1 percent to 75 percent of top soil removed.

(d) Class 4. Severe erosion, over 75 percent of all the top soil or the upper part of the subsoil removed.

(e) Class 5. Very severe or sub-soil erosion. (Sheet erosion of the lower sub-soil and parent material).

(2) Slip Erosion

(a) Class 6. Slips (show symbol thus CC)

(3) Accumulations

(a) Class +. Recent colluvial and alluvial deposition.

(4) Gully Erosion

(a) Class 7. Occasional gullies more than 100 feet apart.

(b) Class 8. Frequent gullies less than 100 feet apart.

(c) Class 9. Destroyed by gullying.

(d) Class S. Numerous shoestring gullies or rills 2"-4" deep.

(5) Gully Erosion Classification

(a) Class A gullies
Shallow gullies which may be crossed with tillage implements to drill on contour are to be designated by the symbols 7 or 8.

(b) Class B gullies
Deep gullies which cannot be crossed by tillage implements to drill on contour or are deep enough to interfere with stock movement to be designated by the symbol (7) (8).

(c) Individual gully delineation
-1- Shallow gullies that can be crossed with tillage implements to drill on contour or livestock to be indicated by a solid red line and 4 dots thus:

-2- Individual deep gullies that cannot be crossed with tillage implements to drill on contour or interfere with livestock movement to be indicated by a solid red line and two dots, thus: —— · · —— · ·

(6) Stream Erosion

(a) Bank cutting to be indicated by use of hachures in red placed along the banks, thus: 

4. SLOPE CLASSIFICATION

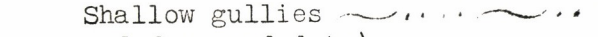
(a) As shown in Soil Conservation Service procedure for making conservation surveys, modified to indicate slope classifications through use of the following symbols:

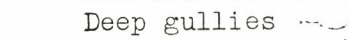
Symbol	Spread of Slope Percent
E	0 - 19
F	20 - 39
FF	40 - 59
G	60 - 79
H	80 +

(Reason - no mechanical reseeding or trenching about 59 percent slope)

5. MAP SYMBOLS

Standard U. S. Maps and Surveys symbols will be used for showing all culture except for items indicated below:

Shallow gullies  (Solid red line and four red dots)

Deep gullies  (Solid red line and two red dots)

Stream erosion (bank cutting)  (red hachure on side of stream at point of bank cutting)

Slip erosion

Accumulations +

Delineations:

In delineating the composite symbol for soil type, including range in depth of top soil remaining, cover, percent of slope and character or erosion, solid black line is to be used.

6. RECOMMENDED CONTROL MEASURES

(a) Channel treatment

(1) Channel treatment
(2) Revetments
(3) Wingwalls
(4) Training wall
(5) Check dam
(6) Stream bank planting
(7) Channel bottom planting
(8) Channel straightening
(9) Others

(b) Slope treatment

(10) Planting - contour drilling
(11) Planting - broadcasting
(12) Contour trenching
(13) Planting - transplanting
(14) Check dams
(15) Fencing
(16) Restricted grazing

Show in green or black with dash between symbols if combinations are used.